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THE THEATER SIMULATION OF AIRBASE

RESOURCES AND LOGISTICS COMPOSITE MODELS:

A COMPARISON

THESIS

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AFIT/GLM/LSM/87S-15

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AFIT/GLM/LSM/87S-15

THE THEATER SIMULATION OF AIRBASE RESOURCES AND LOGISTICS COMPOSITE MODELS: A COMPARISON

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

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In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

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Preface

The purpose of this study was to continue the process begun by Captain David Noble in a previous thesis, to determine if TSAR could match the results of LCOM. The models were compared on the basis of manhours per sortie and sorties flown.

No significant difference was found between the two models' manhours per sortie, but the sorties flown by the models were significantly different. This difference (less than 4 percent) is believed to be caused by the values assigned to the numerous TSAR variables used in assigning aircraft to missions. Differences and similarities between the two models' input requirements and features were noted. TSAR can model a greater spectrum of the wartime environment, but lacks network building programs. This makes the building of TSAR data bases a more cumbersome task.

I am indebted to many others for the assistance they provided me in conducting this experiment and writing this thesis. I would like to thank my thesis advisor Lt Col John Halliday for his guidance and endless patience. I would also like to thank Richard Cronk of Aeronautical Systems Division and Martha Berger, Jeanette Filsinger, and Pam Martin of Simulation Modeling Consultants for their help in learning TSAR. Finally, I wish to thank my wife Laura for her understanding and support as well as her editing assistance.

Gregg A. Clark

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Abstract

The purpose of this study was to determine if, given similar data bases, the Theater Simulation of Airbase Resource (TSAR) model could duplicate the results of the Logistics Composite Model (LCOM). To make this determination the models were compared on the basis of two outputs -- manhours per sortie and sorties flown.

Two previous studies (a thesis by USAF Captain David Noble and a study conducted by Simulation Modeling Consultants of Dayton Ohio) that attempted to answer this question were reviewed and analyzed. This study made use of and built upon the work accomplished in these two previous efforts.

Both models were provided common data bases having similar tasks, task probabilities, task sequence, resource requirements, and sortie requests. Each model was run for ten replications at three different levels of requested flying activity. These levels represented daily sortie rates of 1.0, 2.0, and 3.0 sorties per aircraft per day. The manhours per sortie expended by the individual Air Force Specialty Codes (AFSCs) represented in the data bases, and the number of sorties flown, were gathered for each replication and level. The manhours per sortie were compared on both a statistical and practical basis. The results of this

comparison concluded that no significant difference existed between the two models'. The sorties flown by the models were statistically compared at each of the three levels of requested flying activity. The results showed that a significant statistical difference existed between each models' output sorties flown. At each level the LCOM model flew more sorties than did the TSAR model, however this difference (less than 4 percent) is believed to be caused by the values assigned to a number of user specified variables that are used by TSAR in assigning aircraft to missions.

During the course of this study many differences and similarities between the two models' input requirements and features were noted. TSAR provides the analyst with the ability to model a greater spectrum of the wartime environment than is provided by LCOM. TSAR, however, being a newer model than LCOM, does not provide the analyst the up-front network building programs that LCOM provides. This makes the building of TSAR data bases a more cumbersome task. This study also compared the computer execution times of these two models and found TSAR to be 5 to 8 times faster than LCOM. If analysts find TSAR's unique features useful, this study recommends that the resources be expended to build such up-front programs.

THE THEATER SIMULATION OF AIRBASE RESOURCES AND LOGISTICS COMPOSITE MODELS: A COMPARISON

I. Introduction

General Issue

The Logistics Composite (LCOM) model and the Theater Simulation of Airbase Resources (TSAR) model are two monte-carlo computer simulation models developed by the Rand Corporation and used by the Air Force. Both models simulate the interaction of various resources and their impact on the generation of aircraft sorties (16:1; 12:Chap I,1). The LCOM model has been institutionalized by the Air Force and primarily used by the manpower community to determine direct aircraft maintenance manpower requirements (9). The more recently developed TSAR model, however, is not fully institutionalized by any one particular Air Force community (22). As with any model, LCOM is limited in the situations to which it can be applied, therefore, manpower analysts are seeking alternative models (6; 7; 22). The TSAR model is a possible alternative; it has the capability to model a wider spectrum of situations than the LCOM model (16:2). At least in part because TSAR is unproven in its ability to provide the same predictions of manpower requirements as LCOM, TSAR has not been accepted by the manpower community (7; 22). If it can be substantiated that TSAR is as acceptable a predictor as LCOM of manpower requirements, the

manpower analysts' ability to model wartime manpower requirements could be enhanced by TSAR's unique features.

Specific Problem

A thesis written by Capt. David Noble entitled Comparison Of The TSAR Model To The LCOM Model attempted to demonstrate that TSAR output could duplicate that of the LCOM model (26). His effort showed that the TSAR sortie production and manhour outputs were statistically different than those of the LCOM model although that difference remained constant on a per sortie basis across a range of sortie rates. But he suggested this difference could be attributed to differences between the two data bases used. The TSAR data base was structured for wartime, while the LCOM data base was structured for peacetime. Though adjustments were made to make the two as identical as possible, the question remains: given common data bases, can TSAR output manhours and sorties flown match those of LCOM? Common data bases are operationally defined as data bases having the same tasks, task probabilities, task sequence, resource requirements, and sortie demands.

Research Questions

1. Can TSAR duplicate the results of a LCOM simulation given common data bases? Specifically, the hypotheses that:

a. TSAR and LCOM output manhours per sortie flown

do not differ given common data bases and three levels of sortie demands.

b. TSAR and LCOM output sorties flown do not differ given common data bases and three levels of sortie demands.

2. How are common features implemented in each model?

Scope of Research

LCOM and TSAR both offer a myriad of options and numerous output statistics. It is too much for any one thesis research effort to compare all of the LCOM and TSAR options and outputs, nor is it necessary. To narrow the scope of this research to manageable proportions several decisions were made to limit the input, simulation options activated, and output compared.

A hypothetical aircraft maintenance data base representing one wing of 72 aircraft was modeled. Unscheduled maintenance was limited to nine aircraft systems. Scheduled maintenance included pre-flight and post-flight tasks only. Resource levels were not constrained. The failure and maintenance of support equipment, to include avionics test stations, was not modeled. Nor were the features of munitions build-up, parts cannibalization and cross utilization of manpower activated either.

The sorties flown in a given time period, and the manhours required to produce those sorties, are two primary driving factors used by the manpower community in forecast-

ing manpower requirements. Therefore, the outputs compared between the LCOM and TSAR models were limited to sorties flown and manhours utilized per sortie. To provide greater utility to this study, manhours utilized per sortie flown was used for comparison in lieu of straight manhours. If the sorties flown by each model do in fact differ, a valid manpower comparison cannot be made using straight manhours. However, by dividing the total manhours by the actual sorties flown a valid comparison can still be made even if the sorties flown differ.

Background

LCOM and TSAR are both stochastic discrete event simulations (25:4; 16:1) that simulate the interrelations among resources required by the activities necessary to generate aircraft sorties (16:1; 19:4). Specifically, TSAR simulates the interaction of 11 different classes of resources: (1) aircraft, (2) aircrews, (3) ground personnel, (4) support equipment, (5) aircraft parts, (6) aircraft shelters, (7) munitions, (8) TRAP (Tanks, Racks, Adapters, and Pylons), (9) POL (petroleum, Oil, and Lubricants), (10) building materials, and (11) airbase facilities (16:1). LCOM simulates the interaction of four types of resources: (1) aircraft, (2) personnel, (3) parts, and (4) equipment and facilities (12:Chap IV,15).

Although TSAR and LCOM both simulate facilities (i.e. aircraft shelters, taxiways, runways, and repair shops),

TSAR does so in much greater detail. TSAR, along with its companion model TSARINA, can simulate the impact of an airbase attack and the recovery from such an attack (16:92). During these attacks, facilities, as well as other resources (personnel, parts, equipment, aircraft), can be damaged or destroyed. Activities that require resources that are damaged or destroyed are either delayed, cancelled, or processed by an alternate set of resources. Airborne aircraft that require a destroyed or damaged runway can be diverted to another base (16:3). Post attack recovery includes the simulation of explosive ordnance disposal personnel clearing unexploded munitions from the taxiways and runways as well as civil engineers performing emergency repairs to essential taxiways, runways, shelters and repair shops (16:117-123). LCOM treats facilities just as it does equipment, the facility is either in use or is available for use.

TSAR also has the ability to model Chemical Warfare (CW) conditions (16:124). This ability includes the use of CW ensembles and their imposed constraints (mobility, visibility, dexterity, communications) on personnel while performing maintenance tasks (16:124-126). TSAR also allows a special rest period for personnel to recuperate from the stress, heat, and fatigue brought about by wearing these ensembles (16:125).

The input data bases to both LCOM and TSAR are structured similarly. These data bases represent the actual requirements necessary to operate the specific weapon system in a given environment. The user defines the degree of detail to be simulated by building task networks. These networks describe the interrelations of the tasks to be accomplished, the resources required by each task, the task duration, sequence of tasks, and the probability of each task's occurrence (8:2-4; 14:7). Figure 1 is a an example of an LCOM on-equipment unscheduled maintenance task network. This network consists of a troubleshoot task followed by either a minor maintenance action and a verify task, or a remove and replace action followed by a verify task. TSAR would network this similarly. In LCOM this information is input via form 11s and 12s, in TSAR a Card Type (CT) 5 is used. The input images of these forms and cards for this network are provided in Figure 2. See references 9 and 17 for a complete description of these input formats.

Together these task networks compose the activities necessary to launch and recover aircraft. These activities include; unscheduled maintenance actions, if a component fails or is battle damaged; scheduled maintenance actions, such as, phase inspections, pre- and post-flight inspections; refueling, from a truck or hot pit; aircraft reconfiguration; munitions build-up; equipment repair; and

facility repair, to include, taxiways, runways, shelters, and repair shops.

LCOM. The LCOM software was first written in 1966; it has undergone many revisions and improvements

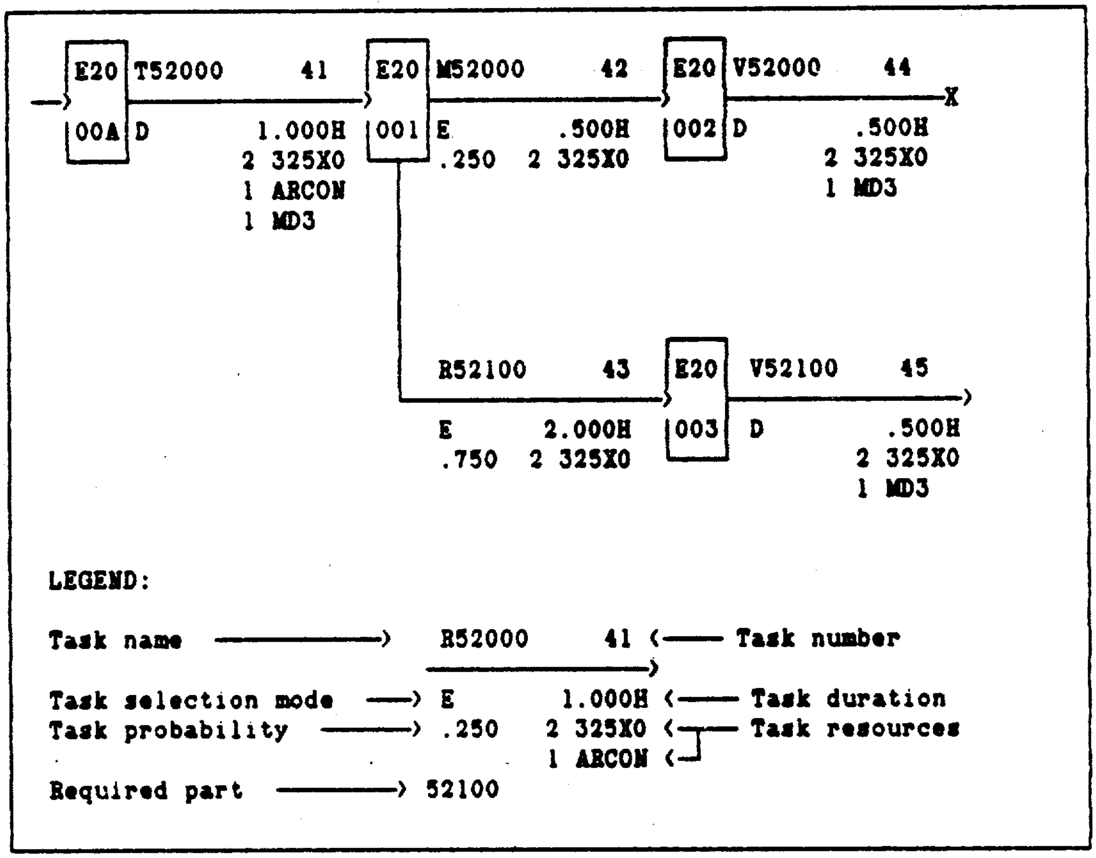

Figure 1. LCOM Auto Pilot Repair Network

since this version (12:Chap I,1-3). The software includes a pre-processor that aids in the formatting of the input data and various post processors that assist the analyst in interpreting the results of a simulation (12:Chap II,1-4). The LCOM system is composed of several subsystems (12:Appen-

dix J). The Data Preparation and Data Structuring subsystems, "extract historical weapon system failure and maintenance task data from the Maintenance Data Collection (MDC) system", and build a "data base of optimized task oriented

```
           1         2         3         4         5         6
  12345678901234567890123456789012345678901234567890123456789012

                           LCOM FORMS

form  task         task
  #   name         time                 required resources

  12 M52000 22  .500H      C          325X0  2
  12 T52000 22 1.000H      C          325X0  2 ABCON  1 MD3     1
  12 V52000 22  .500H      C          325X0  2 MD3    1

form  prior  task  next       task
  #   node   name  node       prob.

  11 E2000A T52000 E20001 D
  11 E20001 M52000 E20002 E  .250
  11 E20001 R52100 E20003 E  .750
  11 E20002 V52000        D
  11 E20003 V52000        D

                           TSAR CARDS

card task shop      task    required  task    parallel subsequent
type  #    #        time   resources  prob.     task      task

  5  41   1         20    2 2      18221000               42
  5  42   1         10    2 2          -250     43        44
  5  43   1         40    2 2          -750               45
  5  44   1         10    2 2        22 1000
  5  45   1         10    2 2        22 1000
```

Figure 2. Example of Model Input Data

networks of the weapon system's maintenance actions" (12:Appendix J). These networks generally use alpha/numeric task names that consist of an action taken code and a work

unit code (8:Chap IV,8-10). This makes the networks both readable and trackable by the analyst. The Simulation subsystem consists of three modules (12:Chap II,1-4). The first module, or input module, translates and reduces the input data base to a form that can be read by the main module (12:Chap II,1). This input module also provides the user with dictionaries that cross reference the user specified name for tasks, resources, missions, etc. with an assigned number that is used by the simulation (12: Chap III,11). These dictionaries are the users prime interface with the simulation model itself (12:Chap III,11) The second, or main module, is the actual simulation program (12:Chap II,4). The third module consists of various post-processors that provide more detailed post simulation analyses than provided by the main simulation reports. (12:Chap II,4)

LCOM has gained wide acceptance in the Air Force. Its users and uses include: (1) Aeronautics Systems Division, determining manpower requirements for evolving weapon systems; (2) Air Force Logistics Management Center, evaluating logistic resource allocation decisions; (3) Air Force Logistics Command, analyzing spares; (4) Air Force Test and Evaluation Center, assessing operational suitability of weapon systems; and (5) Military Airlift Command, Strategic Air Command, Tactical Air Command, United States Air Forces Europe, and Pacific Air Forces, determining

maintenance manpower requirements (9:Sec 2,1-2). A study conducted by McDonnell Astronautics Company has also demonstrated LCOM's use to forecast system readiness in a wartime environment (5:ii).

The LCOM model has been historically validated numerous times by comparing simulation results with real world results (12:Chap I,3). Specific weapon system models have also undergone statistical analysis that has proven the logic and accuracy of the LCOM software (12:Chap I,3). The wide acceptance of LCOM in the Air Force community is evidenced by the fact that it is now an Air Force standard data system, ADPS-14 (12:Appendix J,2). A contract has been let (LCOM 2000) to Synergy, Inc. of Washington, D. C. to ensure that LCOM keeps pace with changes in the logistics concepts of new weapons systems, and to explore the future evolution of the LCOM software (7).

There are drawbacks to LCOM, however. Some authors have been critical of LCOM for its long run times. Hoeber, in Military Applications of Modeling states LCOM is ". . . huge and cumbersome. . . . and one-half to two hours CPU time are required for one LCOM run." (23:116). This run time, however, is very much dependent upon the complexity of the data base and the machine on which it is being run. LCOM is written in SIMSCRIPT II.5 (9:Sec 2,2). SIMSCRIPT II.5 is considered one of the most powerful simulation languages in use (25:124), but it has limited portability,

since SIMSCRIPT II.5 compilers are not widely available and are quite expensive to develop and buy (7; 22).

TSAR. TSAR was written in response to a requirement to model wartime situations that existing models could not model, or easily be modified to model (15:2-4). LCOM was an early candidate for modification, but was rejected because of its lengthy run time and the difficulty of the required modifications (15:4; 22). An important objective in the design of TSAR "was to achieve a sufficiently high speed of operation that the extensive (often trial and error) sequence of runs so frequently necessary in research and analysis would be economically practical" (16:2). TSAR, as stated above, can simulate a wider spectrum of situations than LCOM (16:2). It can simulate the impact of airbase attacks on sortie generation, including chemical attacks and the use of individual chemical protection equipment (16:12).

TSAR also has the ability to model an entire theater consisting of numerous airbases and the interactions among them (17:1). This feature includes the ability to transfer aircraft to rear maintenance repair areas for specific tasks or whenever the estimated repair time exceeds a user specified length (16:46). Resources (parts, equipment, personnel) may also be managed at a theater level and can be reallocated among bases as they are lost due to battle and/or as imbalances occur (16:153, 156-164). Lateral supply support of spare parts may also be accomplished in

TSAR (16:164). TSAR, if the user so specifies, can also allocate the requested sorties to the base within the theater which can best fill the demand at that time (16:88). LCOM, on the other hand, can model multiple locations but has none of these capabilities.

TSAR, however, lacks the many of the pre- and post-processor utilities that LCOM has. This makes the building of the data base and interpreting the output a more cumbersome task (7). Synergy Incorporated (under contract to Air Force XORC) has recently completed several pre-processors for TSAR (22). These pre-processors have the ability to query several standard Air Force data bases, extract existing resource levels for Air Force units, and build the appropriate TSAR input cards (22). To date though, no pre-processors have been built for TSAR that will query Air Force maintenance data bases and build the appropriate maintenance task networks. However, the Air Force Human Resources Laboratory, Logistics and Human Factors Division is currently managing two separate programs that are examining the feasibility of developing such a pre-processor and a graphics post-processor for TSAR (1:37).

TSAR has been used by Rand for several studies including an analysis associated with the analytical justification of the European Distribution System, and a study of "alternative resource levels on the sustainability of combined arms brigades" (15:13; 22). Additionally, TSAR has been

used to simulate three F-4E units operating in a wartime NATO environment (15:13). Other Air Force users of TSAR include the Logistics Management Center, the Aerospace Medical Research Laboratory with contracts to JAYCOR, Air Force Studies and Analysis with contracts to Orlando Technology Incorporated, Air Force XORC with contracts to Synergy Incorporated, and the Air Base Survivability Program Office with contracts to Orlando Technology Incorporated (15:13; 22).

TSAR, like LCOM, has been validated, but Emerson states that TSAR has undergone limited validation (14:6). This validation consisted of comparing TSAR results with those of LCOM and an exercise (Salty Rooster) at Hahn AB (14:6; 22). Although no specific documentation of what comparisons were made is available, Emerson states that the results were "quite similar" (14:6). TSAR output has also been compared favorably with the results of two other exercises, Salty Demo and Commando Rock (22). Salty Demo has been its most significant validation to date, however the documentation relative to TSAR and Salty Demo is classified (13; 22).

LCOM, as stated above, has an up-front family of programs to convert raw maintenance data into a usable format -- LCOM networks. Since no such programs exist for TSAR, its data bases have been built from data contained in existing LCOM data bases and by conducting field surveys at operational bases (4). The TSAR user must also manually

build dictionaries that cross reference the task names, resource names, mission names, etc. to a numerical reference that is used to build the TSAR data base. This has led the users of LCOM to erroneously believe that TSAR is not a stand alone model but ". . . designed to be fed by LCOM data bases . . ." (2). Orlando Technology Incorporated, under contract to Air Force Studies and Analysis, has documented four such TSAR data bases. They have built TSAR data dictionaries for the F-4E, A-10, F-16, and F-15 weapon systems (4). It was this F-16 data bases that Noble used in his research (26:54).

Manpower analysts claim that the TSAR data bases have been compressed (maintenance tasks combined and averaged) (7; 26; 34). This was true of early versions of the TSAR model which were limited to the level of detail that could be networked. This has lead to much confusion in the manpower community as to TSAR's ability to model the level of detail they require (22). In the mid 1970's, when TSAR was initially developed, available computer memory was limited due to its cost; to achieve the objective of short run times compression of the data was necessary. In recent years, however, computer memory has become less costly, and TSAR has been modified to take full advantage of the increased memory made available in modern computers. With the increased memory capacity of modern computers, and by efficient processing, TSAR can retain its advantage of high

speed (15:4). In the current version of TSAR there does not appear to be a need for data compression since TSAR "will function comfortably at many levels of detail" (16:11). TSAR is also much more portable than LCOM, since it is written in FORTRAN, and a compiler is available for most computers. TSAR could be run on any computer which supports a FORTRAN compiler and virtual memory (22). It is currently run on IBM and CRAY mainframe computers as well as VAX, Apollo, and Sun mini computers (22). Another version of TSAR, CWTSAR, has been run by JAYCOR in a micro computer environment using a PC/AT type computer with an Opus board installed (22; 21; 33) The Air Force Human Resources Laboratory is also managing a program to develop a personal computer version of TSAR (1:36-37).

Previous Comparisons

Little has been written on the comparison of these two models. Noble's thesis was the first specific study to compare these two models (26). His effort showed a significant statistical difference between LCOM and TSAR output manhours and sorties flown (26:29). Yet, he questioned the validity of this finding by stating that the two data bases lacked common assumptions (26:42). He made several recommendations for further research to overcome this difference (26:45).

A second study, which was a follow-on to Noble's thesis, was conducted by Simulation Modeling Consultants

(SMC) under contract to Aeronautical Systems Division (ASD/ENSSC) (3). The purpose of their study "was to manually create a TSAR data base from a simple LCOM data base and compare the manpower output" (3:ii). Their effort was intended to be a preparatory step for writing an automated conversion program that would convert a LCOM data base into a comparable TSAR data base (3:ii). It also compares features of each model and explores their philosophical differences.

The LCOM data base they used for their conversion, and basis for their comparison of the models, was the LCOM F-36 Training Problem, which is provided in the LCOM documentation (3:Sec 2.1). This data base was modified to account for philosophical differences between the two models prior to its conversion (3:Sec 2). The training problem data base, although simple as compared to a more complex data base such as an F-16 data base, can exercise many of the models features. Table I provides a comparison of the size of this sample problem to the size of the F-16 data base as documented by Orlando Technologies.

Once the data bases were completed both models were run for ten replications of 45 and 60 days, and the output manhours and sorties completed were compared (3:Sec 1). The study found that total manhours provided by the two models were very close, but there was greater discrepancy between individual AFSC manhours (3:ii). Their study did not

include any statistical analysis of the output, but the manhours for four AFSCs which showed the greatest variation between models were plotted (3:Sec 4,1,6-9). SMC noted that LCOM consistently flew more sorties, had more part failures, and hence, more manhours (3:Sec 4,1). They did state, however, that this difference was not great (3:Sec 4,1).

Table I. Data Base Comparison
(Values from 3:Sec 2,14-16; 27)

	# of Task Networks	# of Tasks	# of Parts	Types of Equipment	# of AFSCs
Training Problem	5	90	5	8	8
F-16	93	1583	271	51	25

One problem they found with TSAR was its EXTEND feature, which allows simulations greater than 65 days in length, was not operative (3:Sec 4,1). Because of this limitation they limited their simulations to 60 days and were unable to achieve a steady state condition with TSAR (3:Sec 4,1). Under the definition used by SMC, steady state was achieved if total and individual AFSC manhours varied by less than five percent, from the average, in a series of simulations in which only the initial random number seed was varied (3:Sec 4,1). SMC concluded that TSAR is not acceptable for manpower studies until this problem is corrected (3:ii). From a traditional manpower determination perspec-

tive this point may be valid. Law and Kelton make a distinction between terminating and steady state simulations (25:280-282). A terminating simulation is one in which the "desired measures of system performance are defined relative to the interval of simulated time" (25:280). A steady-state simulation is defined as "one for which measures of performance are defined as limits as the length of the simulation goes to infinity" (25:281). Law and Kelton further state that "for some systems either type of simulation might be appropriate, depending on what the analyst wants to learn about the system" (25:281). As an experienced Manpower Management officer this researcher knows that manpower requirements are traditionally based upon a steady state condition. However, there has been recent interest in determining wartime surge manpower requirements and surge sortie generation capability given a set level of resources (manpower included). This researcher proposes that a terminating simulation is just as appropriate for this comparison, and while assigned to the Tactical Air Command's Manpower Studies and Analysis Team did, in fact, use the LCOM model in this fashion. The surge time period of a conflict is of a defined length, and it is the sortie generation capability within this time period that is used to measure the system performance. Since both models will be started with the same conditions, empty and idle, and both are simulating the same transient conditions, this

researcher believes that a valid comparison can still be made between the two models regardless of whether a steady state is achieved or not. The outcome of this study should help users determine if resources should be expended to correct the problem identified by SMC with the EXTEND feature so that TSAR could be used for simulations greater than 65 days in length.

SMC experienced some difficulty in translating the Mean Sorties Between Maintenance Actions (MSBMA) data used in LCOM to the failure rate per sortie data that TSAR requires. This may have contributed to the differences they found between LCOM and TSAR generated sorties, parts demands, and manhours used. In LCOM a failure mechanism or failure clock is used to induce component failures (maintenance actions) into the simulation (12:Chap IV,17-19.1). A component's failure clock is usually specified as being exponentially distributed with a mean equal to its historical mean sorties, or flying hours between maintenance actions. As each sortie is flown the failure clock is decremented by 1, or by the actual flying hours if the clock is expressed in terms of mean flying hours between maintenance actions. When the failure clock breaches zero the particular component fails, and the value of the failure clock is reset (12:Chap IV,18). TSAR, however, uses a probabilistic method to induce component failures (maintenance actions) in a simulation. Failures, or breakrates, as termed in TSAR, are

expressed as a probability of a failure per sortie (16:34-42). To convert an LCOM failure rate, expressed as MSBMA, to the equivalent TSAR failure rate, as expressed by the probability of failure per sortie, you simply take the reciprocal of the LCOM MSBMA. For example, if the LCOM MSBMA was 10 for a particular component, the probability of failure per sortie that would be used in TSAR would be 1/10 or .10. This conversion was not used in SMC's study. Table II shows the failure rate used in the LCOM data base, the probability of failure used in the TSAR data base, and the probability of failure as determined by the above method. The difference between the actual probabilities used in TSAR and the probabilities as calculated here could account for some of the variance noted between the two models output.

Table II. SMC LCOM/TSAR Failure Rate Comparison

	FAILURE RATE		
COMPONENT	LCOM MSBMA	TSAR PROBABILITY	CALCULATED PROBABILITY
13000	25.00	.020	.040
45000	7.50	.094	.133
52000	10.00	.065	.100
72000	15.00	.047	.066

A second problem encountered by SMC in converting values used in LCOM to their TSAR equivalents illustrates the difficulty of maintaining two complex models such as

TSAR and LCOM. The problem involves the way in which the probability of a shop performing a Not Reparable This Station (NRTS) task is specified. In the LCOM data base several of the parts have mutually exclusive, multiple repair procedures specified, the NRTS task being one of them (3:Sec 2,21-25). There is a probability associated with performing any one of these procedures when the part enters the repair shop. These probabilities are part of the actual task network and are entered on the task's LCOM form 11 (12:Chap VIII,4-5). In TSAR, however, the probability of performing a NRTS action on a part is associated with the part itself, not the task network, and is recorded on the part's Card Type (CT) 23 (17:101-102). In TSAR the NRTS task procedure should be the first procedure specified on the CT 8/3 for a part with multiple repair procedures (17:52-53). If this procedure is not to be used for any other repair task (as is the case in the LCOM networks) its probability should equal zero (17:53). When making the network conversion from LCOM to TSAR the remaining task probabilities should be adjusted so that they sum to one. For example, given there are three repair procedures (a NRTS procedure and two others) associated with a part in LCOM and their probabilities of occurring are .10, .30, and .60 respectively, then the percent NRTS that should be placed on the CT 23 would be 10, and the probabilities associated with each repair procedure on the CT 8/3 will be 0, .33 [.30/(.30

+ .60)], and .67 [.60/(.30 + .60)] respectively. Because the documentation was not clear on this point, SMC used the LCOM probabilities on the CT 8/3 for all tasks and used a standard NRTS percent of 33 percent on the 23 for all parts (3:Sec 2,28). This could also have contributed to the differences between LCOM and TSAR as noted in SMC's report.

This study effort is a follow on to both Noble's thesis and SMC's study. To the extent possible it will make use of and build upon the work accomplished in these two previous efforts. In the same vain it will attempt to resolve the discrepancies identified in the previous studies and answer the question -- do TSAR and LCOM, given the same input data, produce the comparable output results?

Summary

Because of limitations in LCOM, manpower analysts are searching for alternative models to use in predicting wartime aircraft maintenance manpower requirements. TSAR has the capability to simulate a broader spectrum of the wartime environment than LCOM, but TSAR has not been accepted by the manpower community as an alternative to LCOM. The fundamental question remains: given similar input data, can TSAR produce the same results as LCOM? The purpose of this research is to answer this question.

Two previous studies have attempted to answer this question. Noble was unsuccessful, due possibly to the use of dissimilar data bases. SMC's study did not answer the

question because they were unable to reach a steady state simulation and differences existed between the two data bases.

TSAR includes many features that the LCOM model lacks. TSAR, however, suffers from the lack of up-front task network building programs and pre- and post-processors that enhance LCOM. Since the initial TSAR data bases were built from existing LCOM data bases many analysts were given the false impression that TSAR is dependent upon LCOM. If it can be shown that TSAR provides output as acceptable as LCOM, manpower analysts could benefit from its use as an alternative to LCOM.

II. Methodology

General Approach

An experimental approach will be used for this study. Such an approach is appropriate when the interest is in how variables (manhours per sortie and sorties flown) vary when other variables (model and sortie rate) are manipulated. This, according to Dominowski, is the definition of an experiment (11:33). Each simulation model is an experimental process in itself in that variables of interest can be varied and their impact on output variables examined. This makes implementation of an experiment designed to compare the two simulation models relatively easy.

Specific Method of Approach

A factorial experimental design will be used for this study. The factorial design allows us to consider the effect of multiple independent variables (factors) upon the dependent variable (20:216). The factorial design requires us to choose at least two levels for each independent variable (31:372). It then requires that measurements, in this case simulations, be made for every possible combination of factor and level (25:373). Figure 3 provides the design matrix for this experiment.

The analysis of the experiment results will enable us to answer research question 1 -- can TSAR duplicate the results of a LCOM simulation given common data bases? The

remaining research question will be answered in the process of gathering the data necessary to conduct the experiment.

FACTOR A - MODEL	FACTOR B - TDSR		
	1.0	2.0	3.0
LCOM			
TSAR			

Figure 3. Factorial Design for Comparing LCOM and TSAR (manhours per sortie/sorties flown)

<u>Specification of Independent Variables</u>. As Figure 3 illustrates there are two independent variables, or factors, of interest in this study. Since the objective of this research is to determine whether TSAR output can match that of LCOM, the factor of primary interest and its levels is:

Factor A - model used

Level 1 - LCOM

Level 2 - TSAR

The objective also entails determining if TSAR output can match that of LCOM at varied levels of flying activity. Thus the input factor that will be varied and its levels is:

Factor B - Target Daily Sortie Rate (TDSR)

Level 1 - 1 scheduled sortie per aircraft per day.

Level 2 - 2 scheduled sorties per aircraft per day.

Level 3 - 3 scheduled sorties per aircraft per day.

<u>Specification of Dependent Variables</u>. The output variables of concern are manhours expended per sortie and actual sorties flown. Values for both will be obtained from each simulation and compared for each combination of factors and levels.

Experimental Controls

The goal of an experiment is to examine the relation of independent variables and dependent variables without other variables interfering with or "confounding" the relationship (11:61). To prevent confounding, control over as many variables as possible is desired (11:62). Therefore, to the extent possible, only those features that are common to both models and implemented the same in each will be activated or used in this experiment. Both data bases will be tailored to these considerations.

Dominowski states that randomization should be used to prevent confounding by variables beyond the experimenter's control (11:16). Law, however, states that randomization in a simulation experiment is not necessary, assuming the random number generator is working properly (25:372). Law

also points out that simulations based upon random inputs, such as LCOM and TSAR, produce random outputs (25:142). To control the impact of this randomness multiple (ten) simulation runs will be made for each factor/level combination, and an average will be computed for each combination.

Criteria for Analysis

Hypotheses. The overall purpose of this analysis is to test the following two sets of hypotheses:

H_o: TSAR and LCOM output manhours per sortie do not differ.

H_a: TSAR and LCOM output manhours per sortie do differ.

H_o: TSAR and LCOM output sorties flown do not differ.

H_a: TSAR and LCOM output sorties flown do differ.

Statistical Method. Since the two simulation models will be using different sets of random number streams the samples from each model are considered to be independent (25:351). If the samples are independent we are able to use statistical methods to make inferences about the two population means and test the above hypotheses (28:138). Additionally, if the data can also be assumed to come from approximately normally distributed populations with equal variances, a Student two sample t test can be used (28:142). These two assumptions are less critical than the assumption of independence. If the assumption of normality cannot be

assumed the Wilcoxon rank sum test can be used as an alternative to Student's t test (28:142).

To test the assumption of normality the Shapiro-Wilk statistic, W, will be used (32:591-611). This statistic has been shown to be an effective measure of normality for small samples (n<20) (32:602). The UNIVARIATE procedure in SAS, a computer based statistical package, will be used to compute the W test statistic to test the hypothesis that both models' output manhours per sortie flown come from a normally distributed population (29:1137). This hypothesis will be tested for the individual AFSC manhours per sortie at each of three target sortie rates. The number of sorties flown by each model will be tested in a similar manner. Since a 95 percent confidence level is desired, the above hypotheses will be rejected if the p-value for the computed W test statistic is less than .05 (28:121-123). The p-value is defined as the probability of observing a value as contradictory to the null hypothesis, assuming the null hypothesis is true, as the computed test statistic (28:121).

Ott states, that if equal sample sizes are used, as is the case in this study, the general conclusion is that the "population variances can differ by as much as a factor of 3" and the Student t test will still apply (28:142). For the purposes of this study equal population variances will be assumed.

The possibility exists, as SMC's study suggests, that the manhours per sortie produced by each model could be equal in the aggregate, yet different if examined at the individual AFSC level (3:ii). Since manpower requirements are determined at the AFSC level, and not in aggregate, it is desired to determine if a manhour per sortie difference exists at the AFSC level between models. For this reason the first set of the above hypotheses will be tested for each individual AFSC contained in the data bases at each of the three TDSRs. If it can be assumed the data come from a normally distributed population, as tested above, the Student t test will be used to test the hypotheses, and the SAS TTEST procedure will be used to compute the Student t test statistic (30:795-798). If the assumption of normality cannot be met the Wilcoxon rank sum test will be used to test the hypothesis and the SAS NPAR1WAY procedure will be used to compute the test statistic (30:607-614). Whichever procedure is used a 95 percent confidence level is desired. Therefore, if the p-value of the test statistic is less than .05 the null hypothesis will be rejected. If this occurs a significant statistical difference will be said to exist between the two values being tested.

Decision Rules

Even though a significant statistical difference may exist between the two models output manhours per sortie for a particular AFSC/TDSR combination, no practical difference

may exist. A practical difference is defined to exist if the equivalent manpower, computed using the difference between the AFSC's mean manhours per sortie, calculated from each model's output equals or exceeds the minimum crew size for that AFSC. The minimum crew size for a particular AFSC is the largest crew size required of that AFSC for any single task in the data base and "must be provided in order to do any flying or accomplish any of the required maintenance" (8:Chap 6:9-10). The formulation of this decision rule is based upon both this researcher's experience in conducting manpower simulation studies, and other experts' opinion (6; 22). Equivalent manpower is computed as the product of the difference between the two models' mean manhours per sortie for the AFSC in question, the TDSR at which the difference was detected, the number of aircraft simulated, and the average days per month, divided by the Manhour Availability Factor (MAF). In a wartime environment it is assumed that there are 30.44 days per month (10). The MAF is the total manhours per month that an individual is assumed to be available for duty, and is used by the manpower community to determine manpower requirements. There are currently two wartime MAFs in use, 244 and 309 (24). The factor of 244 is used in determining sustained wartime manpower requirements, and the factor of 309 is used in determining surge manpower requirements (24). Since the MAF of 244 is more restrictive it will be used in the above

calculation. For the purposes of this study a difference will not be declared significant unless it is both statistically and practically significant. For example, if a significant statistical difference exists for AFSC 328X0 at the TDSR of 2, and the minimum crew size is 2 (the largest crew size on any single task for this AFSC in the data base is 2) the computed equivalent manpower would have to equal or exceed 2 for a practical difference to exist. If the difference between the two models' mean manhours per sortie was .05 the equivalent manpower would equal .898*. Since this value is less than the minimum crew size of 2, no practical difference exists and hence no significant difference exists.

The results of testing the first set of hypotheses for each individual AFSC and TDSR combination leads to the decision matrix shown in Figure 4. Based upon the number of significant differences, a decision must be made at each sortie rate level to accept or reject the first set of hypotheses. Since no test statistic could be found to make this determination a subjective decision rule was formulated. The hypothesis will be accepted, for a given sortie rate level, if at that level no more than 25 percent of the total AFSCs reflect a significant difference.

---

* (.05 manhours per sortie X 2 sorties per aircraft per day X 72 aircraft X 30.44 days per month)/ 244 manhours per month per person

	SIGNIFICANT DIFFERENCE IN MANHOURS PER SORTIE ? (yes/no)		
AFSC	TDSR 1	TDSR 2	TDSR 3
1			
2			
3			
.			
.			
.			
TOTAL NUMBER SIGNIFICANT			

Figure 4. Manhour Per Sortie Decision Matrix

The results for all three levels can then fall into one of three categories.

1. The null hypothesis is rejected at all three levels

2. The null hypothesis is rejected at one or two levels

3. The null hypothesis is not rejected at any of the three levels

If the results fall into category 1 the conclusion would be that the two models' output manhours per sortie do in fact differ. If, however, the results fall into category 3 the equality of the two models' output manhours per sortie can not be refuted. Results that fall in the second category would be inconclusive. If the results do fall into the first or second category an examination of the data will be made to find any tendencies that may be of significance to this study.

When the second set of hypotheses are tested results can fall into one of these three same categories. As above, if the results fall into category 1 the conclusion would be that the two models' output sorties flown do in fact differ. If, however, the results fall into category 3 the equality of the two models' output sorties flown can not be refuted. Results that fall in the second category would be inconclusive. If the results do fall into the first or second category an examination of the data will be made to find any tendencies that may be of significance to this study.

III. Findings and Analysis

Description of the Actual Experiment

There were three steps used in the comparison of these two models. First, the data bases were constructed and made as compatible as possible. Second, the simulations were run for ten replications at each of the three levels of flying activity. And third, the outputs of the simulations were analyzed.

The Data Bases

The baseline data base used for this study was the modified F-36 LCOM sample problem data base built by SMC for their study effort (3). Additional task networks derived from an F-15 LCOM data base, provided by Headquarters Tactical Air Command Manpower Studies and Analysis Team (HQ/TAC/XPMS), were also included in the data base used for this study. The addition of these networks increased the number of task networks and the number of tasks from 5 and 90 to 10 and 192 respectively. The number of AFSCs doubled from 8 to 16 and the number of parts in the data base increased from 5 to 15. Adding these tasks and their resources to the data base increased the amount of activity and interaction during the simulation and hopefully, provides greater validity to this study. In this same vain the number of aircraft simulated was increased from 24 to 72. The aircraft phase inspection networks included in

SMC's data base were retained but were not activated for this analysis. The LCOM and TSAR data bases used for this study are provided in Appendix A and B respectively.

As stated earlier, TSAR data bases use a numerical reference for tasks and their associated resources. The numbering scheme developed and used by SMC for building their TSAR data base was retained (3:Sec 2, 4). The task number assigned by the LCOM input module, as shown on the control table index (12:Sec III, 14), was used to reference the same task in the TSAR data base. Likewise, the index number assigned to a resource by the LCOM input module, as shown in the resource dictionary (12:Sec III, 11-12), was used to reference the identical resource in TSAR. These task and resource dictionaries are shown in Appendix C.

TSAR and LCOM differ in the way they assign and account for manpower resources. TSAR uses a shop concept, whereas LCOM uses an AFSC concept, to assign and account for manpower (12:Chap X,2; 17:37-38). In TSAR all tasks, personnel, equipment, and parts are assigned to shops, or workcenters, and the number of shops is limited to 30 (17:37-38). Of these 30, only 24 are available for use by the modeler (17:37-38). Shop 25 is allocated for scheduled flight line activities, 26 is used internally for storing references to aircraft whose mission assignment has been delayed, 27 for reconfiguration, 28 for munitions loading, 29 for refueling, and shop 30 is used for civil engineering

and munitions assembly (17:38). Each of these shops may have multiple AFSCs assigned to it and may also borrow resources from other shops, but the manhours are accumulated and output as one total for each shop (17:38). LCOM uses AFSCs to account for manpower, and the user is unlimited in the number of AFSCs permitted. Each AFSC's manhours are reported separately. In LCOM each manpower resource is identified by its AFSC (i.e. 325X0) and a resource index number assigned by the input module (12:Chap X,2; 12:Chap III,11-12). A dictionary of the LCOM AFSC, its resource index number, and TSAR shop number to which it is assigned is also provided in Appendix C.

In both LCOM and TSAR the user can specify the distribution to be used for any particular task's duration (12:Chap VIII,6; 17:43-49). In LCOM the user chooses between eight types (normal, log-normal, exponential, poisson, empirical, erlang, weibul, triangular) of distributions and supplies the parameters required by the particular distribution (i.e. mean and variance) (12:Chap III,3-4). TSAR is more limiting in its use of distributions. There are currently 11 predefined distributions of three types (4 log-normal, 4 uniform, 3 normal) defined in TSAR; 'each is represented with 25 discrete values of the 'sample' value relative to the mean' which is supplied by the user (18:131). Since this difference could not be reconciled, and because the use of different distributions in each model

could induce unwanted variance between the models' output, constant task times were used in each data base.

The Flying Schedules. Both LCOM and TSAR use similar input formats to input the requested flying schedules. The largest difference is that in LCOM the flying schedule (form type 20s) can be stored in a file separate from the remainder of the data base and can be separately read and interrupted by the input module (12:Chap III,4-5). The TSAR flying schedule, CT 50s, can be stored separately but must be input, read, and initialized with the rest of the data base (17:163-167). Three flying schedules, one for each of the desired sortie rates of 1, 2, and 3 sorties per aircraft per day, were developed for this study. A 16 hour take-off window was allowed with the first take-offs scheduled at 0530 and the last scheduled at 2030. Since control of as many variables as possible was desired to prevent confounding, a specified take-off time was supplied for each mission. However, both LCOM and TSAR have features which allow the random generation of a user specified number of mission requests per a given time block (12:Chap 4,41-42; 17:163-167). Figure 5 provides a profile of sortie requests by hour of the day. Three mission types, each requiring two aircraft (a minimum of one was required to launch) and different configurations, are included in these flying schedules. Here again, to prevent confounding, a constant sortie duration of 1.5 hours was used. For this

same reason ground aborts, weather delays, and weather aborts were not included in these flying schedules. TSAR mission 1 is referred to as "FERRY" in LCOM and represents 8 percent of the sortie demands. TSAR mission 2 is referred to as "CLSPT" in LCOM and represents 50 percent of the total sortie demands. Finally, TSAR mission 3 is referred to as "SMTBM" in LCOM and represents 42 percent of the sortie demands. The input flying schedules are provided in Appendix D.

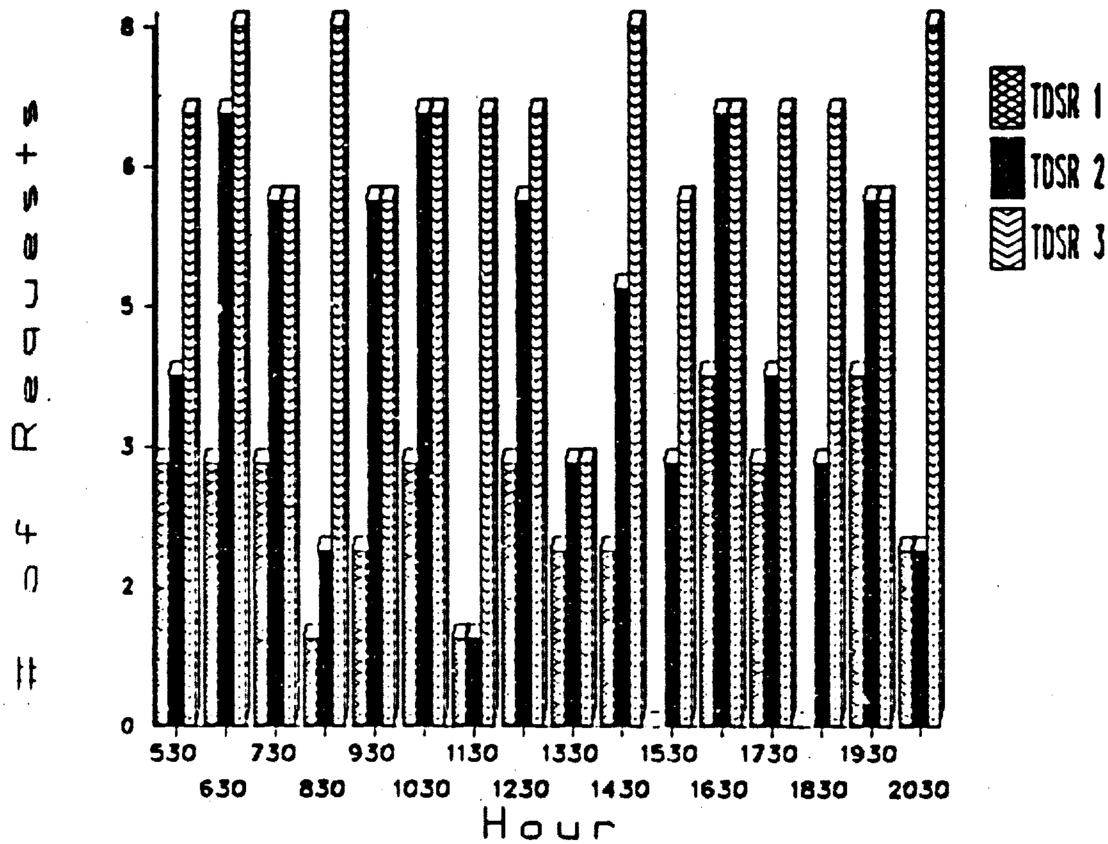

Figure 5. Mission Requests By Hour

Production Runs

Both models were run on the same computer, a NAS 7000 an IBM compatible mainframe. Ten replications of 60 days each were run for both of the models at each of the three target daily sortie rates (TDSRs) -- 60 total simulations. TSAR has a feature (NTRIAL) which allows the multiple replications of a simulation to be made in one computer run (17:18). LCOM has no such feature, and each replication must be submitted individually. When used TSAR's NTRIAL feature provides output statistics for the individual replications as well as average statistics computed across all replications (16:24-25). It should be noted that if the TSAR EXTEND feature, which permits simulations greater than 65 days, is activated, multiple replications are not possible (17:18). An unstated objective of this study was to compare the execution time of TSAR and LCOM simulations. Since a one-for-one comparison could not be made if multiple replications were run during the same computer execution, the NTRIALS feature was not used for this study.

A series of debugging runs were made prior to the actual production runs to identify any errors in the input data bases, and to ensure compatibility had been achieved. All identified errors were corrected. However, four warning messages issued by TSAR were never resolved. These four messages were of the same type. The first warning message read -- 'WARNING: MORE TYPE 1 PERSONNEL ARE REQUIRED FOR

PARTS REPAIR PROCEDURE #1035 THAN THE MINIMUM SHOP SIZE AT BASE #1". The other three messages read the same, except that the parts repair procedures referenced were 1038, 1039, and 1040. These messages were suspect for two reasons. First no type 1 personnel were defined nor referenced in the data base, and secondly, no parts repair procedures numbered such as these, were used. After numerous trial and error iterations, the cause of these messages was isolated to the CT 8/2s and CT 8/3s associated with the part numbers 35, 38, 39 and 40. The input format and data of the suspect cards was verified, and no errors were found. There are five other parts in the data base which have multiple repair procedures and require CTs 8/2 and 8/3, none of these five created warning messages. The only unique feature of the four parts that caused these messages was that their "first location", the numerical identity of the first repair procedure on the CT 8/2s and 8/3s, were numbered greater than 99. A dump of the initialized arrays was made, and the arrays associated with these two card types were verified, yet no discrepancies were found. Keying on this difference the numerical identity of these repair procedures were changed to values less than 99, and a simulation was run against this data base. The warnings were not produced in this simulation. A comparison of both simulations' output was made, and no differences were found. Since no difference was found in the output and no discrepancies were

noted in the dumps of the original arrays, a decision was made to keep the original numerical identity of these repair procedures. This would maintain the integrity of the task numbering scheme as identified previously.

The output manhours for each AFSC, or shop in TSAR, and the sorties flown, were extracted from each of the 60 simulations. These outputs, along with the calculated manhours per sortie for each AFSC, are identified by model and run number in Appendix E.

Analysis of The Output

Application of the Shapiro-Wilks Test. The first step in the analysis of the output was to test the data for normality. As was stated in Chapter II the Shapiro-Wilks statistic was used to test the hypothesis that both models' output manhours per sortie are normally distributed. This hypothesis was tested for every combination of model, AFSC, and TDSR. Of the 16 AFSCs contained in the data bases five rejected this hypothesis (p-values less than .05). The AFSCs along with the identity of the models and TDSRs for which the hypothesis was rejected are shown in Table II. For the combinations of AFSCs and TDSR shown in Table III the Wilcoxon rank sum test was used to test the hypothesis of equality between the two models output manhours per sortie. The remaining combinations were tested using the Student's t test.

The Shapiro-Wilks test was also used to test the output sorties flown by each model at each of the three TDSRs for normality. The sorties flown in LCOM at TDSR 1 rejected the hypothesis (p-value less than .05) that they are normally distributed. Therefore, the Wilcoxon rank sum test was used in lieu of the Student t statistic to test the equality of the models' output sorties flown at TDSR 1.

Table III. Results of the Shapiro-Wilks Test

AFSC	MODEL AND TDSR AT WHICH REJECTED
423X1	TSAR - 1, 2, & 3
423X3	LCOM - 1,2, & 3; TSAR - 1 & 2
427X5	TSAR - 1
462X0	LCOM - 3; TSAR - 3
462X1	LCOM - 1, & 2; TSAR - 3

<u>Application of the Specific Statistical Tests</u>. As stated in Chapter II the hypotheses to test the manhours per sortie for the individual AFSCs at each of the three TDSRs:

H_0: TSAR and LCOM output manhours per sortie do not differ.

H_a: TSAR and LCOM output manhours per sortie do differ.

For those combinations of AFSCs and TDSRs shown in Table III these hypotheses were tested using the Wilcoxon rank sum test, for all others the Student t test was used. Regardless of the test used a confidence level of 95 percent was desired, and the null hypothesis was rejected if the p-value

for the test statistic was less than .05. Table IV identifies the combinations of AFSCs and TDSRs that rejected the null hypothesis. Also included is the difference between the two models' mean manhours per sortie for each of these combinations.

Table IV. TDSR/AFSC Combinations Which Rejected H_o

TDSR	AFSC	MEAN MANHOURS PER SORTIE		DIFFERENCE
		LCOM	TSAR	
1	423X3	0.75000	0.74840	+0.0016
1	462X0	2.03669	2.10350	-0.0668
1	462X1	2.7500	2.74482	+0.0052
2	423X3	0.74997	0.74969	+0.0003
2	427X5	0.01140	0.01033	+0.0011
2	431X1	3.02637	3.04068	-0.0143
2	462X0	2.16478	2.06254	+0.1022
2	462X1	2.75017	2.74560	+0.0046
3	423X3	0.74999	0.74945	+0.0005
3	431X1	3.05397	3.04245	+0.0115
3	462X0	2.06080	1.98199	+0.0788
3	462X1	2.78556	2.74747	+0.0381

In Chapter II the hypotheses to test the equality of the sorties flown by the two models at each of the three TDSRs were stated as follows:

H_o: TSAR and LCOM output sorties flown do not differ.

H_a: TSAR and LCOM output sorties flown do differ. As stated above, the Wilcoxon rank sum test was used to test these hypotheses at TDSR 1. The tests performed for TDSR 2 and 3 used the Student t test. Regardless of the test used a confidence level of 95 percent was desired, and the null hypothesis was rejected if the p-value for the test statistic was less than .05. All tests rejected the null hypothesis. Table V identifies the mean sorties flown for the two models at each of the TDSRs. The difference between the two is also included. The specific output from each of these tests are provided in Appendix F.

Table V. Sorties Flown at Each TDSR

TDSR	SORTIES FLOWN		DIFFERENCE
	LCOM	TSAR	
1	4320	4305	15
2	8632	8418	214
3	11632	11129	503

Application of the Decision Rules. The next step in the analysis of the output was to apply the practical difference test to those AFSC/TDSR combinations that showed a significant statistical difference. A practical difference was defined to exist if the equivalent manpower, (computed with the formula specified in Chapter II, using the differences identified in Table IV), equals or exceeds

the maximum crew size for the particular AFSC being tested. Table VI shows the equivalent manpower for each of the AFSC/TDSR combinations that showed a significant statistical difference between the two models' output manhours per sortie (Table IV). As Table VI shows none of the equivalent manpower calculations equal or exceed the minimum crew size for its respective AFSC, therefore no practical difference exists between the two models output manhours per sortie for these AFSC/TDSR combinations.

The decision rule in Chapter II states that no significant difference between the two models' output manhours per sortie for a particular AFSC/TDSR combination will be declared to exist unless the difference is both statistically and practically significant. None of the statistically significant differences shown in Table IV are practically significant, therefore none are significant for the purposes of this study.

As stated in the methodology, the null hypothesis would only be rejected at a specific TDSR level if 25 percent or more of the individual AFSCs reflected a significant difference at that TDSR. Since none of the AFSCs reflect a significant difference at any of the TDSRs, the null hypothesis cannot be refuted at any of the three TDSRs.

Applying the categorization rules, as shown in Chapter II, these results fall into category 3 -- The null hypothesis is not rejected at any of the three levels. This leads

Table VI. Results of Practical Difference Test

TDSR	AFSC	MIN CREW SIZE	EQUIVALENT MANPOWER	PRACTICAL DIFFERENCE
1	423X3	1	.054	NO
1	462X0	5	.600	NO
1	462X1	2	.047	NO
2	423X3	1	.005	NO
2	427X5	1	.020	NO
2	431X1	4	.257	NO
2	462X0	5	1.836	NO
2	462X1	2	.083	NO
3	423X3	1	.013	NO
3	431X1	4	.310	NO
3	462X0	5	2.123	NO
3	462X1	2	1.027	NO

to the conclusion that the equality of the two models output manhours per sortie flown cannot be refuted.

Applying these same categories to the outcomes of the hypotheses testing the equality of the sorties flown by the models at each of the three TDSRs, we see they fall into category 1 -- The null hypothesis is rejected at all three levels. This leads to the conclusion that the sorties flown by each of the two models are in fact different.

Discussion of the Results

Several factors may have contributed to the finding of significant statistical differences between the two models for the AFSC/TDSRs shown in Table IV.

First, several of the AFSC's (423X3 and 462X1) output manhours per sortie had no or very small variances (because output manhours per sortie were constant or very close to constant). Because the two statistical tests use the variance or the ranks of each observation, a significant statistical difference could be found for negligible differences between the two sets of values being compared. The small variances of these AFSCs were likely a result of the data base structure. These AFSCs are required on a very limited number of tasks in the data base, most of which are required to be performed for each sortie and as stated in the methodology, constant task times were used to prevent confounding.

Another factor which may have contributed to a statistical significant difference being found for AFSCs 427X5 and 423X1 is the manner in which each model reports the manhours used by a particular AFSC. TSAR rounds the manhours and reports the manhours used in tens. LCOM on the other hand reports the manhours used in units of 1. For most AFSCs this has little impact, since there are usually hundreds of manhours used by a given AFSC during a simulation. But, two AFSCs in this limited data base expended less than 100

manhours in each of the simulations, even at the TDSR 3 the highest number used was 174. For AFSC/TDSR combination 423X1/1 the reported manhours used in TSAR was either 0 or 10 for each of the ten replications. The rounding at this level could result in a significant statistical difference being found.

The fact that the two data bases differ in the manner they handled post-flight tasks could also be a contributing factor for the significant statistical difference found between the two models for AFSC 431X1. In LCOM a unique set of pre- and post-flight tasks can be identified for each specific mission type (12:Chap 4,8). In TSAR, however, these tasks can only be defined uniquely for each aircraft type. In the LCOM sample problem data base, from which the data base used for this study was initially built by SMC (3), different post-flight tasks were defined for each of the three mission types. Each of these tasks require AFSC 431X1, but a different quantity and task duration were specified for each. SMC, in the data conversion to TSAR, created a task network which contained these mission peculiar post-flight tasks (3:Sec 3,4). Each of these tasks were assigned probability values equal to the probability of flying the particular mission with which it was associated. If 100 percent of the requested missions are flown, the correct tasks are processed the proper number of times. As missions are missed due to resource limitations etc. they

are not necessarily missed in the same proportion as they are requested. The probabilities associated with these tasks will no longer be accurate, since they are based upon requested missions not missions actually flown and TSAR links the accomplishment of post-flight tasks with the actual flight of a mission. Since TSAR did not accomplish a 100 percent of the missions, and the missed mission types not flown were not always proportional to the mission types requested, we can assume that this factor contributed to the difference between the two models for this AFSC.

A forth contributing factor to the statistical differences found could possibly be the sample size used. This could be especially true of the difference found at all three TDSRs for AFSC 462X0. At TDSR 1, TSAR's output manhours per sortie was greater than LCOM's. At TDSR 2 and 3, LCOM's was greater, but there was a lesser difference at TDSR 3 than at 2. The relatively small sample size of ten replications could possibly have contributed to this fluctuation.

An additional factor should be considered when 462X0 (weapons loaders) manhours are disscussed. Although the weapons loaders reflected the largest difference in manhours per sortie between the two models, it would be unfair to judge or compare the two models on the basis of this difference. Weapons loaders are unique in that they perform little if any corrective maintenance actions. The manpower

requirements for weapons loaders are driven by the required size of the load crew and the requested flying schedule. To a large degree both of these factors are the results of policy decisions and operational requirements. When large crew sizes (a crew size of five was specified for weapons loaders in this data base) are used for virtually every task required by an AFSC, a slight difference in the number of tasks accomplished in each model could result in a significant manhour difference. Since each of these models uses a different philosophy to assign aircraft to missions, it would not be unexpected that there be a slight difference in the number of aircraft reconfigurations accomplished in each model. The timing and spacing of demands for weapons load crews are largely determined by the requested flying schedule. A flying schedule which includes 'waves' of missions would usually drive a higher requirement for weapons load crews than a smooth flow schedule. To satisfy the 'wave' schedule a large number of aircraft must be loaded/reconfigured in a short period of time. This creates a peak demand on load crews which must be fulfilled if the missions are going to be flown.

Since both models produced the same manhours per sortie flown, the difference in the sorties flown between the two models does not appear to have been caused by differences in the number of maintenance actions performed per sortie. This researcher believes that this difference (less than 4

percent in each case) may have been caused by user specified values that are used by the models in assigning aircraft to missions. The two models have drastically different philosophies in assigning aircraft to missions. In comparison, LCOM's is rather simplistic.

In LCOM assignment of an aircraft to a mission is based mainly on two variables: (1) lead time, as specified on a mission's form 20 form 21 for a particular reconfiguration network (12:Chap 8,27; 12:Chap 4,26). The lead time is specified by the user and represents the amount of time prior to a mission that the simulation is notified of its existence. Its value is usually set equal to the maximum expected time necessary to complete the presortie tasks (12:Chap 8,27). (2) cut off time, also specified by the user, is the expected time required to complete the necessary reconfiguration and presortie tasks (12:Chap 4,26). The simulation is notified of a particular mission's aircraft requirement at the mission's takeoff time minus the mission's lead time. The simulation then searches for an available aircraft of an acceptable configuration having a cut off time less than the difference between the current simulation time and scheduled takeoff time. This search continues until an aircraft is assigned, or the mission is canceled for lack of an aircraft.

TSAR uses a much more complex but more realistic approach to assign aircraft to missions. TSAR makes status

projections of aircraft supply and demand, and it is within the context of these two projections that aircraft are assigned to a particular mission (16:59-60). These projections are made every two hours for a specified time horizon that is time of day dependent. If the default values are used (as they were for this study) there values are 12 hours from 2400 to 0400, 8 hours from 0401 to 1600, 20 hours from 1601 to 2000, and 16 hours from 2001 to 2359 (16:60). These time to time horizons are divided into 16 blocks and the aircraft demands and estimated aircraft ready times are associated with the appropriate time block (16:60). These projections are based upon at least six additional user supplied variables in the TSAR data base -- a pre- and post-flight delay, spacified on the CT 15/1 (17:65); a nominal unscheduled time and nominal cycle time, specified on the CT 15/1 (17:65); a network mean time for each task network, specified on CT 5 (17:43-49); and the hours notice given for a particular mission, specified on CT 50 (17:163-167). The documentation is unclear, at least to this researcher, as to how each of these variables is used or its input value best determined. Nor is the sensitivity of the model to changes in these variables known. Where possible the values used for this study were the default values or values known to have worked in past studies. For example, Noble used a value of 18 hours notice for all missions, the same value was used for this study. Other values such as the network

mean time was calculated by flowing through the networks and summing the task times for the most probable tasks. This researcher feels that the reason TSAR did not fly as many sorties as LCOM is hidden somewhere in these variables, but due to time constraints was unable to conduct a range of sensitivity runs to test this hypothesis.

Additional Findings Relative to Research Question 2

Research question 2 is -- How are common features implemented in each model? Both Nobel's thesis (26) and SMC's study (3) comment on a number features and compare their implementation in both TSAR and LCOM. This researcher chose to address several features (in addition to the ones already addressed else where in this study) which have not been compared in these two previous studies but may be of interest to potential users.

Cannibalization. Each of the two models simulate the cannibalization parts from one aircraft to another when none are available from the supply system (12:Chap 4,34; 16:54-57). In both, users are able to specify the parts that are eligible for cannibalization along with the time and resources necessary to remove the part from the donor aircraft (12:Chap 4,34; 16:54-57). TSAR users are also able to specify an administrative delay to be associated with each cannibalization action. This delay could represent the time spent to reach the decision to cannibalize the part. Users of both models are also able to specify the maximum

number of holes permitted in a donor aircraft. LCOM users can, additionally, specify the maximum number of parts that can be cannibalized for any one aircraft. Only NMCS (Not Mission Capable Supply) aircraft are considered as either acceptors or donors in LCOM. In addition to this requirement, each donor and acceptor aircraft must satisfy a list of requirements that are realistic but beyond the modelers control.

The TSAR user is given somewhat more flexibility in modeling cannibalization actions. In addition to being able to more explicitly specify which aircraft (only of the same type) may be considered as donors, he may specify whether or not a part may be cannibalized when repairables exist on the base (16:54). Four possible categories exist for donor aircraft in TSAR (16:54). The first consists of aircraft with parts missing, but whose criticality for the designated mission would not be affected. The second category consists of all aircraft with parts missing; the third, consists of aircraft without holes, if the part's criticality would not affect the designated mission. The forth category consists of all other aircraft. The first and third category are possible, since each task and part can be designated critical or non-critical for each mission type in the TSAR data base (17:42). The TSAR user may also prohibit cannibalization of a part from an aircraft whose ready-to-fly time is within a user specified number of hours (16:55).

Cannibalization may also be prohibited for a part unless at least a minimum number of aircraft, as specified by the user, are in need of that particular part. Another facet of the cannibalization feature in TSAR is the ability to cannibalize SRUs (Shop Replacement Units) from two or more LRUs (Line Replacement Units) within a shop to make one good LRU -- an important ability LCOM lacks. The user of TSAR may also specify a probability that the part being cannibalized will be broken in the process of being removed.

Warm-up Feature. As stated in Chapter I achieving a steady state condition was not considered to be a prerequisite of conducting the comparison of these two models. Shannon, however, makes the point that when we conduct simulation experiments we usually want to study the systems under typical day-to-day conditions (31:182). With stochastic models such as LCOM and TSAR, however, there is an initial transient condition, bias, that is atypical of normal day-to-day conditions (31:182). A preferred remedy for this condition is to throw out or exclude some of the initial period (31:182). LCOM has a 'warm-up' feature that allows us to do this. The user specifies the initial number of simulation days that are not to be included in the output statistics (12:Chap 4,39) An additional feature in LCOM simulates partial failure clock usage; this is accomplished by multiplying each failure clock in the data base by a

random between 0 and 1.0, thus reflecting partial use of the clock (12:Chap 4,39).

TSAR, however, utilizes a different approach. TSAR enables the user to initiate a simulation in an other than empty and idle state. The user can specify the initial status of the shops, levels of parts repair activity, and initial aircraft status (17:101,134-135). This allows the simulation to start in the desired state if values can be determined for all the necessary input variables.

Comparison of Execution Times

As was stated earlier a secondary objective of this study was to compare the computer execution times of each model given like data bases. Table VII compares the mean execution time (measured in CPU (Central Processing Unit) seconds used) for each of the models at the three TDSR levels. Although TSAR did not fly as many sorties as LCOM, the additional execution time required by LCOM is not proportional to the difference in the number of sorties flown. TSAR execution time ranged from 5 to 8 times faster than LCOM's. The LCOM execution time did not include any of the post processors. Each of the TSAR simulations were run individually, the most inefficient way to run TSAR. When TSAR's NTRAILS feature is used to run multiple replications in one execution, the input data needs only to be read, interpreted, and error checked once, and likewise, many of the arrays need only to be initialized once. If this

feature had been used the total run time for each TSAR replication would be less than the averages shown in Table VII.

Table VII. Comparison of Model Execution Times
(CPU seconds on a NAS 7000 computer)

TDSR	LCOM	TSAR
1	469.50	88.35
2	975.38	163.04
3	1705.61	211.94

The importance of this increased speed lies in the advantages it gives an analyst or manager. The faster execution time of TSAR means, in many cases, the difference between an overnight turnaround of a simulation and the same day turnaround. This is an important difference when many simulations must be conducted, and the input to each simulation depends on the results of the previous simulations. This is usually the case when performing manpower studies. The faster execution results in a cost savings as well. Computer time is not free and each additional CPU second costs the user dollars. The savings generated from faster execution times could be used to conduct additional simulations or analyses that otherwise could not have been conducted.

IV. Conclusion and Recommendations

Implications of Findings

The findings of this study lend credence to Noble's suspicions that the statistical differences found in his study between the manhours produced by each of the models were a result of data base differences and not differences between the two models (26:30-31). Even though statistical differences were found in this study, no practical differences exist between the manhours per sortie produced by each model. Given that both models use varied approaches and incorporate different philosophies, it was surprising that so few statistical differences were found. The sorties flown by each of the models were significantly different. This difference though is suspected to be caused by the values assigned, by this researcher, to the numerous variables TSAR uses to schedule aircraft.

With growing budgetary constraints on the monies made available to procure weapon systems, spares, and other necessary support, coupled with a dwindling pool of manpower resources, there is a growing need to more accurately and realistically define our wartime requirements. A systems approach to requirements determination can help fulfill this need, and TSAR takes such an approach, more so than LCOM. TSAR can capture the impact of airbase attacks, chemical warfare, reallocation of resources among bases in a theater of operation, deferred maintenance, and rear area main-

tenance. Lines of communication can be simulated, as can air traffic control activities, and shipments between bases. LCOM has limited or no ability to model these aspects of the wartime environment. If manpower analysts, or analysts from other functional areas within the Air Force, feel as though they could use these capabilities, it would be advantageous to expend the resources necessary to build the network generating and data base building pre-processors to aid them in the development of data bases.

TSAR is not a panacea for all manpower modeling situations. True, the LCOM model is limited to the situations to which it can be applied, but as with any model TSAR also has its limitations. For example, because of its current limitation of only modeling two twelve hour shifts its applicability to a peacetime environment may not be appropriate without modifications. The bounds of the problem at hand, compared to the capabilities and limitations of each model, should be the basis for selecting the model to be used.

The building of any simulation model is a continual evolutionary process. TSAR is a relatively new model and has lots of room for development. It has taken years of iterations and modifications to bring LCOM to the state it is today.

Recommendations for Further Research

This study is the third to examine and compare the output manhours and sorties flown by these two models. There are still many questions that can be answered. As Noble pointed out (26:44) the complexity of these models and the learning curve associated with each make it difficult for anyone researcher with limited time to address the many features both models include. This researcher had the advantage of nearly four years experience using the LCOM model, yet still faced quite a challenge in comparing a limited number of features and outputs of the models. Future researchers would be well advised to work with an existing data base, such as the one used here, and become familiar with each model by actually running and exercising the models prior to conducting any serious simulations.

Some recommended areas for future research include:

1. Replicate this study, but pick up where this researcher left of. Perform a sensitivity analysis on the parameters used by TSAR to make the projections of aircraft supply and demand and aircraft assignment to a specific mission.

2. While this researcher was conducting this study many questions arose from the current users of LCOM concerning the comparability of TSAR's features versus LCOM's. Their interest also included how a user could account for features included in LCOM but not specifically incorporated

in TSAR, when building a TSAR data base. The envisioned effort would involve writing a comparison of LCOM and TSAR features, their commonalities, differences, and the practical implications of these to the user. The effort would entail the exploration how LCOM features, not included in TSAR, could possibly be modeled in TSAR.

3. The studies to date have only compared the two models with unconstrained resources. A study could be conducted that compares the models' output and behavior, given constrained resources (i.e. limited manpower).

Appendix A: LCOM DATA BASE

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

*****************************   CHANGE CARD FILE   ****************************

510SWT
STORAC      2            F-36
FLMSWT
NOCLMM      0
PSROUT            0.0
1,2,3,4,5,6,14,33,34,35,49,50,51,55,66, *
RFREQ       1    60.00
BOSTAT           60.0
IPSTAT           60.0
MMSTAT           60.0
QSTAT            60.0
STOP             60.125


********************************   FORMS FILE   ********************************

 13 F-36   I  1 1KK      72
 13 325X0  M001    10K
 13 328X1  M002    10K
 13 423X3  M003    10K
 13 423X4  M004    10K
 13 431X1  M005    10K
 13 432L4  M006    10K
 13 462X0  M007    10K
 13 462X1  M008    10K
 13 326S4  M009    10K
 13 326S5  M010    10K
 13 326X6  M011    10K
 13 326X7  M012    10K
 13 326X8  M013    10K
 13 423X0  M014    10K
 13 423X1  M015    10K
 13 427X5  M018    10K
 13 ARCOM  A001    20K 100
 13 B-4    A002    20K 100
 13 GCART  A003    20K 100
 13 HCART  A004    20K 100
 13 MD3    A005    20K 100
 13 MJ2    A006    20K 100
 13 TJACK  A007    20K 100
 13 TOBAR  A008    20K 100
 13 13A00  P001    20K 100
 13 13B00  P002    20K 100
 13 45100  P003    20K 100
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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


13 52100  P004    20K 100
13 72100  P005    20K 100
13 42CHA  P006    20K 100
13 42CHG  P007    20K 100
13 42CH4  P008    20K 100
13 42CJD  P009    20K 100
13 51EA0  P010    20K 100
13 51ED0  P011    20K 100
13 55AE0  P012    20K 100
13 55AK0  P013    20K 100
13 71DA0  P014    20K 100
13 74EB0  P015    20K 100
13 F13000 C                       25.00   0.  X
13 F45000 C                        7.50   0.  X
13 F52000 C                       10.00   0.  X
13 F72000 C                       15.00   0.  X
13 F42C** C                        17.0   0.  X
13 F51E** C                        80.0   0.  X
13 F55A** C                        21.0   0.  X
13 F71D** C                        13.0   0.  X
13 F74E** C                        40.0   0.  X
24
24 F-36    BOMBS  I      4
24 SYSTEM FUEL    I 555555
12
12 DECACT 31  .050H      C
12 DEJACK 22 1.500H      C         431X1  4 TJACK  4
12 DERACK 22 1.000H      C         462X0  2
12 DEBOMB 22 1.000H      C         462XJ  5 MJ2    1
12 EOR    31  .500H      C         431X1  3 MJ2    1
12 G13A00 23             C *13A00
12 G13B00 23             C *13B00
12 G45100 23             C *45100
12 G52100 23             C *52100
12 G72100 23             C *72100
12 H13000 33 3.500H      C         432L4  2 431X1  4
12 H45000 33 3.000H      C         423X4  2 B-4    1 HCART  1
12 H52000 33 4.000H      C         325X0  2 B-4    1
12 H72000 33 3.000H      C         328X1  2 431X1  4
12 INRACK 22 1.000H      C         462X0  2
12 JTOW   33 1.000H      C         431X1  4 TOBAR  1
12 JWASH  33 2.000H      C         431X1  3
12 K13A00 73 1.000H      C         432L4  1
12 K13B00 73 1.500H      C         432L4  1
12 K45100 73 1.000H      C         423X4  2
12 K52100 73 1.000H      C         325X0  1
12 K72100 73 1.000H      C         328X1  1
12 LANCH1 31  .250H      C         431X1  1 GCART  1
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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


 12 LANCH2 31  .250H      C         431X1 1 GCART   1
 12 LANCH3 31  .250H      C         431X1 1 GCART   1
 12 LOADSB 31 1.000H      C         462X0 5 MJ2     1
 12 MPREFT 31 1.000H      C         462X1 2 B-4     1 MD3    1
 12 M13A00 22  .750H      C         432L4 1
 12 M13B00 22  .750H      C         432L4 1
 12 M45000 22 1.000H      C         423X4 2
 12 M52000 22  .500H      C         325X0 2
 12 M72000 23 1.000H      C         328X1 2
 12 N13A00 31  .500H      C         432L4 1
 12 N13B00 31  .500H      C         432L4 1
 12 N45100 31  .500H      C         423X4 1
 12 N52100 31  .500H      C         325X0 1
 12 N72100 31  .500H      C         328X1 1
 12 PDEPOT 43 10          C
 12 POSTF1 31 1.000H      C         431X1 3 MD3     1
 12 POSTF2 31 1.000H      C         431X1 1 MD3     1
 12 POSTF3 31 1.000H      C         431X1 2 MD3     1
 12 Q13A00 23 1.000H      C         13A00 C 1432L4  1
 12 Q13B00 23 1.000H      C         13B00 C 1432L4  1
 12 Q45100 23 1.000H      C         45100 C 1423X4  1
 12 Q52100 23 1.000H      C         52100 C 1325X0  1
 12 Q72100 23 1.000H      C         72100 C 1328X1  1
 12 REFUEL 31  .750H      C         423X3 1
 12 R13A00 22 1.500H      C         432L4 2
 12 R13B00 22 2.000H      C         432L4 2
 12 R45100 22 2.500H      C         423X4 2
 12 R52100 22 2.000H      C         325X0 2
 12 R72100 23 2.500H      C         328X1 2
 12 SERVHY 31  .750H      C         462X1 1 HCART   1
 12 SORTIE 11
 12 TSHOOT 22 3.500H      C         432L4 3 MD3     1 B-4    1
 12 TSHOOTC               C         TJACK 4
 12 T13000 22 1.000H      C         432L4 2 MD3     1
 12 T45000 22 1.500H      C         423X4 2 MD3     1 HCART  1
 12 T52000 22 1.000H      C         325X0 2 ABCON   1 MD3    1
 12 T72000 23 1.500H      C         328X1 2 ABCON   1 MD3    1
 12 UPJACK 22 2.500H      C         431X1 4 TJACK   4
 12 V13000 22 1.000H      C         432L4 2 MD3     1
 12 V45000 22 1.000H      C         423X4 2 MD3     1 HCART  1
 12 V52000 22  .500H      C         325X0 2 MD3     1
 12 V72000 23 1.000H      C         328X1 2 MD3     1 ABCON  1
 12 W13A00 73 2.500H      C         432L4 2
 12 W13B00 73 2.000H      C         432L4 2
 12 W45100 73 2.000H      C         423X4 2
 12 W52100 73 2.500H      C         325X0 2
 12 W72100 73 2.500H      C         328X1 1
 12 G42CHA 23             C *42CHA
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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

12 G42CHG 23              C *42CHG
12 G42CH4 23              C *42CH4
12 G42CJD 23              C *42CJD
12 G51EA0 23              C *51EA0
12 G51ED0 23              C *51ED0
12 G55AB0 23              C *55AB0
12 G55AE0 23              C *55AE0
12 G71DA0 23              C *71DA0
12 G74EB0 23              C *74EB0
12 H71D00 21 1.500H       C         326X8  1
12 H74E00 21 1.700H       C         326X6  1
12 JDUMY1 22              C
12 JMSH2P 23              C
12 JMSH7P 73              C
12 K51EA0 72 3.500H       C         326S4  1
12 K55AE0 72 4.000H       C         326S5  1
12 K71DA0 72 5.800H       C         326S5  1
12 K74EB0 72 9.600H       C         326S4  1
12 M42C00 21  .900H       C         423X0  1
12 M51E00 21 1.400H       C         326X7  1
12 M51E01 21 2.100H       C         427X5  1
12 M55A01 21 1.400H       C         326X7  1
12 M71D00 21 1.300H       C         326X8  1
12 M71D01 21 2.100H       C         427X5  1
12 M74E00 21 1.600H       C         326X6  1
12 N51EA0 22 5.400H       C         326S4  1
12 N51ED0 22 1.800H       C         326S5  1
12 N55AE0 22 4.000H       C         326S5  1
12 N71DA0 22 6.900H       C         326S5  1
12 N74EB0 22 11.80H       C         326S4  1
12 PDEPOT 43 11D          C
12 Q42CHA 21              C         42CHA C 1
12 Q42CHG 21 2.600H       C         42CHG C 1423X0  2
12 Q42CH4 21              C         42CH4 C 1
12 Q42CJD 21              C         42CJD C 1
12 Q51EA0 21 1.600H       C         51EA0 C 1326X7  1
12 Q51ED0 21 1.600H       C         51ED0 C 1326X7  1
12 Q55AB0 23              C         55AB0 C 1
12 Q55AE0 21 1.200H       C         55AE0 C 1326X7  1
12 Q71DA0 21  .600H       C         71DA0 C 1326X6  2
12 Q74EB0 21              C         74EB0 C 1
12 R42C00 21 2.900H       C         326X6  1
12 R42C01 21 1.100H       C         423X0  1
12 R42C02 21 1.200H       C         423X1  1
12 R51E00 21 1.600H       C         326X7  1
12 R55A00 21 1.400H       C         326X7  1
12 R71D00 21 1.400H       C         326X8  1
12 R74E00 21 2.400H       C         326X6  1
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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


 12 SHOP   23            C
 12 T42C00 21  .800H     C         423X0  1
 12 T51E00 21 1.300H     C         326X7  2
 12 T55A01 21 1.000H     C         326X7  2
 12 T71D00 21  .700H     C         326X8  1
 12 T74E00 21  .300H     C         326X6  1
 12 V42C00 21  .400H     C         423X0  2
 12 V51E00 21 1.000H     C         326X7  2
 12 V55A01 21  .400H     C         326X7  1
 12 V55A03 21  .400E     C         326X7  1
 12 V71D00 21  .500H     C         326X8  1
 12 V74E00 21  .200H     C         326X6  1
 12 W42CHA 73 4.500H     C         423X0  1
 12 W42CHG 73 13.50H     C         423X0  1
 12 W42CH4 73 9.000H     C         423X0  1
 12 W42CJD 73 7.500H     C         423X0  1
 12 W51EA0 72 4.800H     C         326S4  1
 12 W55AB0 72 2.200H     C         326S5  1
 12 W55AE0 72 5.400H     C         326S5  1
 12 W71DA0 72 7.900H     C         326S5  1
 12 W74EB0 72 10.70H     C         326S4  1
 12 X42C00 21 1.000H     C         423X0  1
 12 X51E00 21 1.400H     C         326X7  1
 12 X55A00 21 1.400H     C         326X7  1
 12 X71D00 21 1.300H     C         326X8  1
 12 X74E00 21 2.000H     C         326X6  1
 11
 11 PDEPOT PDEPOT       D
 11 CAS003 PREFLT CAS03A C             LAUNCH FOR CLOSE AIR SUP MISSION
 11 CAS03A LANCH1 CAS004 D             LAUNCH FOR CLOSE AIR SUP MISSION0  00010    11 CAS004 SORTIE
CAS005 S                                             0  00010
 11 CAS005 POSTF1 CAS006 D             POST FLIGHT FOR CAS              0  00010
 11 CAS006 CALLS1        C             CALLING UNSCHEDULED MAINTEN      0  00010
 11 CAS005 REFUEL CAS007SUFUEL   10000                                  0  00010
 11 CAS007        CAS008LEFUEL   20000                                  0  00010
 11 CAS008              ADFUEL  500000                                  0  00010
 11 PREFLT MPREFT       D              CALLED SECTION FOR ALL PRE-      0  00010
 11 PREFLT SERVHY       D              CALLED SECTION FOR SERVICE       0  00010
 11 SMB02A        SMB004GEBOMBS  4                                      0  00010
 11 SMB02A        SMB02BLSBOMBS  4                                      0  00010
 11 SMB02B        SMB003ADBOMBS  4                                      0  00010
 11 SMB003 LOADSB SMB004 D             LOAD SMART BOMBS                 0  00010
 11 SMB004 PREFLT SMB04A C             LAUNCH FOR SB MISSION
 11 SMB04A LANCH2 SMB005 D             LAUNCH FOR SB MISSION            0  00010
 11 SMB005 SORTIE SMB006 S             SB FLYING                        0  00010
 11 SMB006 EOR    SMB007SUBOMBS  4     END OF RUNWAY CHECK              0  00010
 11 SMB007 POSTF2 SMB008 D             POST FLIGHT FOR SB               0  00010
 11 SMB007 REFUEL CAS007SUFUEL   20000                                  0  00010
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

11 SMB008 CALLS1        C              CALL UNSCHEDULED MAINT            0 00010
11 FRY003 PREFLT FRY03A C              LAUNCH FOR FERRY MISSION
11 FRY03A LANCH3 FRY004 D              LAUNCH FOR FERRY MISSION          0 00010
11 FRY004 SORTIE FRY005 S              FERRY FLYING                      0 00010
11 FRY005 POSTF3 FRY006 D              POST FLIGHT FOR FERRY             0 00010
11 FRY005 REFUEL CAS007SUFUEL     5555                                   0 00010
11 FRY006 CALLS1        C              CALL UNSCHEDULED MAINT            0 00010
11 PHASE1 JTOW   PHASE2 D
11 PHASE2 JWASH  PHASE3 D              WASH ACFT FOR PHASE               0 00010
11 PHASE3        PHASE4 E  .500        DUMMY TASK FOR PHASE              0 00010
11 PHASE4 CALLP1 PHASE6 C              CALL #1 PHASE TASKS               0 00010
11 PHASE6 JTOW          D              TOW ACFT OUT OF PHASE             0 00010
11 PHASE3        PHASE5 E  .500        DUMMY TASK FOR PHASE              0 00010
11 PHASE5 CALLP2 PHASE6 C              CALL #2 PHASE TASKS               0 00010
11 CALLP1 H52000        D              INSPECTION OF AUTO PILOT          0 00010
11 CALLP1 H72000        D              INSPECTION OF RADAR               0 00010
11 CALLP2 H45000        D              INSPECTION OF HYDRAULICS          0 00010
11 CALLP2 H13000        D              INSPECTION OF LANDING GEAR        0 00010
11 CALLS1        E2000A FF52000                                          0 52000
11 E2000A T52000 E20001 D              TROUBLE SHOOT AUTO PILOT          0 52000
11 E20001 M52000 E20002 E  .250        REPAIR AUTO PILOT ON ACFT         0 52000
11 E20001 R52100 E20003 E  .750        REMOVE AND REPLACE LRU FOR        0 52000
11 E20002 V52000        D              VERIFY WORK ON AUTO PILOT         0 52000
11 E20003 V52000 E20004 D              VERIFY WORK ON LRU FOR AUTO       0 52000
11 E20004 G52100 E20005 R              COMPONENT IDENTIFICATION FO       0 52000
11 E20004 Q52100        I              DRAW LRU FROM SUPPLY OR CAN       0 52000
11 E20005 N52100 PDEPOT E  .250        LRU FOR AP NOT REPAIRABLE T
11 E20005 W52100        E  .650        CHECKED & REPAIRED LRU FOR        0 52000
11 E20005 K52100        E  .100        LRU FOR AP CHECKED OK             0 52000
11 CALLS1        G20001 FF72000                                          0 72000
11 G20001 T72000 G20002 D              TROUBLE SHOOT RADAR               0 72000
11 G20002 M72000 G20003 E  .300        REPAIR RADAR ON ACFT              0 72000
11 G20003 V72000        D              VERIFY WORK ON RADAR              0 72000
11 G20002 R72100 G20004 E  .700        REMOVE & REPLACE LRU FOR RA       0 72000
11 G20004 V72000 G20005 D              VERIFY WORK ON LRU FOR RADA       0 72000
11 G20005 G72100 G20006 D              COMPONENT IDENT FOR RADAR L       0 72000
11 G20005 Q72100        I              DRAW RADAR LRU FROM SUPPLY        0 72000
11 G20006 N72100 PDEPOT E  .500        LRU FOR RADAR NOT REPAIRABL       0 72000
11 G20006 W72100        E  .350        CK & REPAIRED LRU FOR RADAR       0 72000
11 G20006 K72100        E  .150        LRU FOR RADAR CHECKED OK          0 72000
11 CALLS1        D50001 FF45000        FAILURE CLOCK FOR HYDRAULIC       0 45000
11 D50001 T45000 D50002 D              TROUBLE SHOOT HYD SYS             0 45000
11 D50002 M45000 D50003 E  .400        REPAIRED HYD SYS ON ACFT          0 45000
11 D50002 R45100 D50004 E  .600        REMOVE & REPLACE LRU FOR HY       0 45000
11 D50003 V45000        D              VERIFY HYD SYSTEM                 0 45000
11 D50004 G45100 D50005 D              COMPONENT IDENT FOR HYD SYS       0 45000
11 D50004 Q45100 D50006 I              DRAW HYD LRU FROM SUPPLY OR       0 45000
11 D50006 V45000        D              VERIFY LRU FOR HYD SYSTEM         0 45000
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

11 D50005 N45100 PDEPOT E  .500       LRU FOR HYD NOT REPAIRABLE     0  45000
11 D50005 W45100        E  .400       CK & REPAIRED LRU FOR HYD      0  45000
11 D50005 K45100        E  .100       LRU FOR HYD CHECKED OK         0  45000
11 CALLS1        A30000 FF13000       FAILURE CLOCK FOR LANDING G    0  13000
11 A30000 T13000 A30001 E  .900       TROUBLE SHOOT LANDING GEAR     0  13000
11 A30000 UPJACK A30010 E  .100       JACK AIRCRAFT                  0  13000
11 A30010 TSHOOT A30011 D             TROUBLE SHOOT LANDING GEAR     0  13000
11 A30011 DNJACK A30001 D             REMOVE ACFT FROM JACKS         0  13000
11 A30001 M13A00 A30002 E  .200       REPAIR #1 LRU ON ACFT FOR L    0  13000
11 A30002 V13000        D             VERIFY WORK ON LANDING GEAR    0  13000
11 A30001 R13A00 A30003 E  .300       REMOVE & REPLACE #1 LRU FOR    0  13000
11 A30003 V13000 A30004 D             VERIFY #1 LRU FOR LANDING G    0  13000
11 A30001 M13B00 A30006 E  .200       REPAIR #2 LRU ON ACFT FOR L    0  13000
11 A30006 V13000        D             VERIFY #2 LRU FOR L GEAR ON    0  13000
11 A30001 R13B00 A30007 E  .300       REMOVE & REPLACE #2 LRU LAN    0  13000
11 A30007 V13000 A30008 D             VERIFY REPLACED #2 LRU L GE    0  13000
11 A30004 G13A00 A30005 D             COMPONENT IDENT FOR #1 LRU     0  13000
11 A30004 Q13A00        I             DRAW LRU #1 FM SUPPLY OR CA    0  13000
11 A30005 N13A00 PDEPOT E  .700       #1 LRU NOT REPAIRABLE THIS     0  13000
11 A30005 K13A00        E  .150       #1 LRU CK OK                   0  13000
11 A30005 W13A00        E  .150       #1 LRU CK & REPAIRED           0  13000
11 A30008 G13B00 A30009 D             CMP ID #2 LRU                  0  13000
11 A30008 Q13B00        I             DRAW #2 LRU OR CANN            0  13000
11 A30009 N13B00 PDEPOT E  .300       #2 LRU NRTS                    0  13000
11 A30009 K13B00        E  .150       #2 LRU CK OK                   0  13000
11 A30009 W13B00        E  .550       #2 LRU CK & REPAIRED           0  13000
11 RECON1 INRACK        D             UP LOAD RACKS
11 RECON2 DNRACK        D             DOWN LOAD RACKS
11 RECON3               D             DUMMY TASK TO PROCESS COCKE
11 RECON4 DNBOMB        D             UP LOAD RACKS
11 RECON5 DNBOMB RECON2 D             DOWN LOAD RACKS
11 CALLS1        D2C01  FF42C**                                      0  42C*
11 D2C01  V42C00        A  .015                                      0  42C**
11 D2C01  T42C00        A  .029                                      0  42C**
11 D2C01  X42C00        A  .118                                      0  42C**
11 D2C01  M42C00        E  .603                                      0  42C**
11 D2C01  R42C00 ID2C00 E  .030                                      0  42C**
11 D2C01  R42C01 ID2C00 E  .336                                      0  42C**
11 D2C01  R42C02 ID2C00 E  .031                                      0  42C**
11 ID2C00 SHOP   ID2C01 D                                            0  42C**
11 ID2C01 JNSH2P        E  .629                                      0  42C**
11 ID2C01 JDUMY1 ID2C02 E  .037                                      0  42C**
11 ID2C02 Q42CH4        D                                            0  42C**
11 ID2C02 G42CH4 ID2C03 D                                            0  42C**
11 ID2C03 W42CH4        D                                            0  42C**
11 ID2C01 JDUMY1 ID2C04 E  .074                                      0  42C**
11 ID2C04 Q42CHA        D                                            0  42C**
11 ID2C04 G42CHA ID2C05 D                                            0  42C**
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


 11 ID2C05 W42CHA        D                                              0  42C**
 11 ID2C01 JDUMY1 ID2C06 E  .037                                        0  42C**
 11 ID2C06 Q42CHG        I                                              0  42C**
 11 ID2C06 G42CHG ID2C07 D                                              0  42C**
 11 ID2C07 W42CHG        D                                              0  42C**
 11 ID2C01 JDUMY1 ID2C09 E  .223                                        0  42C**
 11 ID2C09 Q42CJD        D                                              0  42C**
 11 ID2C09 G42CJD ID2C0A D                                              0  42C**
 11 ID2C0A W42CJD        D                                              0  42C**
 11 CALLS1        E1E01  FF51E**                                        0  51E**
 11 E1E01  V51E00        A  .868                                        0  51E**
 11 E1E01  T51E00        A  .316                                        0  51E**
 11 E1E01  X51E00        A  .368                                        0  51E**
 11 E1E01  M51E00        E  .073                                        0  51E**
 11 E1E01  M51E01        E  .218                                        0  51E**
 11 E1E01  R51E00 IE1E00 E  .709                                        0  51E**
 11 IE1E00 SHOP   IE1E01 D                                              0  51E**
 11 IE1E01 JMSH2P        E  .259                                        0  51E**
 11 IE1E01 JDUMY1 IE1E02 E  .593                                        0  51E**
 11 IE1E02 Q51EA0        I                                              0  51E**
 11 IE1E02 G51EA0 IE1E03 D                                              0  51E**
 11 IE1E03 N51EA0 PDEPOT E  .100                                        0  51E**
 11 IE1E03 W51EA0        E  .500                                        0  51E**
 11 IE1E03 K51EA0        E  .400                                        0  51E**
 11 IE1E01 JDUMY1 IE1E05 E  .148                                        0  51E**
 11 IE1E05 Q51ED0        I                                              0  51E**
 11 IE1E05 G51ED0 IE1E06 D                                              0  51E**
 11 IE1E06 N51ED0 PDEPOT D                                              0  51E**
 11 CALLS1        E5A01  FF55A**                                        0  55A**
 11 E5A01  V55A01        A  .185                                        0  55A**
 11 E5A01  T55A01        A  .046                                        0  55A**
 11 E5A01  X55A00 E5A02  A  .169                                        0  55A**
 11 E5A02  V55A03        A  .182                                        0  55A**
 11 E5A01  M55A01        E  .739                                        0  55A**
 11 E5A01  R55A00 IE5A00 E  .261                                        0  55A**
 11 IE5A00 SHOP   IE5A01 D                                              0  55A**
 11 IE5A01 JMSH2P        E  .118                                        0  55A**
 11 IE5A01 JDUMY1 IE5A0A E  .235                                        0  55A*
 11 IE5A0A Q55AB0        D                                              0  55A**
 11 IE5A0A G55AB0 IE5A02 D                                              0  55A**
 11 IE5A02 W55AB0        D                                              0  55A**
 11 IE5A01 JDUMY1 IE5A05 E  .647                                        0  55A**
 11 IE5A05 Q55AE0        I                                              0  55A**
 11 IE5A05 G55AE0 IE5A06 D                                              0  55A**
 11 IE5A06 N55AE0 PDEPOT E  .046                                        0  55A**
 11 IE5A06 K55AE0        E  .227                                        0  55A**
 11 IE5A06 W55AE0        E  .727                                        0  55A**
 11 CALLS1        G1D01  FF71D**                                        0  71D**
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

11 G1D01  V71D00        A  .172                                          0  71D**
11 G1D01  T71D00        A  .276                                          0  71D**
11 G1D01  X71D00        A  .069                                          0  71D**
11 G1D01  H71D00        E  .569                                          0  71D**
11 G1D01  M71D00        E  .035                                          0  71D**
11 G1D01  M71D01        E  .034                                          0  71D**
11 G1D01  R71D00 IG1D02 E  .362                                          0  71D**
11 IG1D02 Q71DA0        I                                                0  71D**
11 IG1D02 G71DA0 IG1D03 D                                                0  71D**
11 IG1D03 N71DA0 PDEPOT E  .159                                          0  71D**
11 IG1D03 W71DA0        E  .477                                          0  71D**
11 IG1D03 K71DA0        E  .364                                          0  71D**
11 CALLS1        G4E01  FF74E**                                          0  74E**
11 G4E01  V74E00        A  .310                                          0  74E**
11 G4E01  T74E00        A  .103                                          0  74E**
11 G4E01  X74E00        A  .379                                          0  74E**
11 G4E01  H74E00        E  .448                                          0  74E**
11 G4E01  M74E00        E  .069                                          0  74E**
11 G4E01  R74E00 IG4E00 E  .483                                          0  74E**
11 IG4E00 SHOP   IG4E01 D                                                0  74E**
11 IG4E01 JMSH2P        E  .071                                          0  74E**
11 IG4E01 JDUMY1 IG4E02 E  .929                                          0  74E**
11 IG4E02 Q74EB0        D                                                0  74E**
11 IG4E02 G74EB0 IG4E03 D                                                0  74E**
11 IG4E03 N74EB0 PDEPOT E  .104                                          0  74E**
11 IG4E03 K74EB0        E  .103                                          0  74E**
11 IG4E03 W74EB0        E  .793                                          0  74E**
14
14 SORTIE C F52000 1.000
14 SORTIE C F72000
14 SORTIE C F45000
14 SORTIE C F13000
14        C F42C**
14        C F51E**
14        C F55A**
14        C F71D**
14        C F74E**
16
16 *          12  12
16 R               7
16   325X0    200 200
16   328X1    200 200
16   423X3    200 200
16   423X4    200 200
16   431X1    200 200
16   432L4    200 200
16   462X0    200 200
16   462X1    200 200
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


16   326S4   200 200
16   326S5   200 200
16   326X6   200 200
16   326X7   200 200
16   326X8   200 200
16   423X0   200 200
16   423X1   200 200
16   427X5   200 200
17
17 FERRY  3  FRY003 CLEAN  CLEAN  FERRY  F-36
17 CLSPT  1  CAS003 RACKS  RACKS  CLSPT  F-36
17 SMTBM  2  SMB02A BOMBS  RACKS  SMTBM  F-36
17 PHASE  2 APHASE1 CLEAN  CLEAN  MPREFT F-36
18
18 1 10
18 2 20
18 3 30
18 4 0     0     0
18 5 .25   .50   .75
18 6 0     0     0
18 7  20    48    48
18 8 1.0
18 9 1.0
1810  5
21
21 CLSPT  CRACKS                 0.0   ARACKS                3.0
21       CCCLEAN RECON1          3.0   ACLEAN RECON1         4.0
21       CABOMBS RECON4          4.0   CBOMBS RECON4         4.0
21 SMTBM  CBOMBS                 0.0   ABOMBS                3.0
21       CARACKS                 4.0   CRACKS RECON3         4.0
21       CCCLEAN RECON1          4.0   ACLEAN RECON1         4.0
21 FERRY  CCLEAN                 0.0   ACLEAN                2.0
21       CARACKS RECON2          3.0   CRACKS RECON2         3.0
21       CABOMBS RECON5          4.0   CBOMBS RECON5         4.0
21 MPREFT ACLEAN                 0.0   ARACKS RECON2         2.0
21       CCCLEAN                 0.0   CRACKS RECON2         3.0
21       CABOMBS RECON5          4.0   CBOMBS RECON5         4.0
```

Appendix B: TSAR Data Base

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


1111                                                           INPUT LIST
 1  4   60    1    141505    1    1
    *****************************************************************
       THIS IS THE FINAL THESIS DATA BASE. DATA BASE IS BASED UPON
       SMC'S F-36 AND SEVERAL SCRUBBED F-15 NETWORKS.
    *****************************************************************
 2  1    0    1    0                  60    1
 3  1    1    0    0    0
 3  3    0    0   20         1
 4  2    0    0    0    0    0    1
 5  40  1                            100             41   70           16
 5  41  1        20   2 2       18221000             42
 5  42  1        10   2 2           -250     43      44
 5  43  1        40   2 2           -750             45
 5  44  1        10   2 2       22  1000
 5  45  1        10   2 2       22  1000             47
 5  47  1    29                     1000                        100
 5  51  2                             67             52  100           16
 5  52  2        30   3 2       18221000             53
 5  53  2        20   3 2           -300     55      54
 5  54  2        20   3 2       18221000
 5  55  2        50   3 2           -700             56
 5  56  2        20   3 2       18221000             58
 5  58  2    30                     1000                        100
 5  62  3                            133             63   70           16
 5  63  3        30   5 2       21221000             64
 5  64  3        20   5 2           -400     65      66
 5  66  3        20   5 2       21221000
 5  65  3        50   5 2           -600             68
 5  68  3    28                     1000             69         100
 5  69  3        20   5 2       21221000
 5  73  4                             40             74   70           16
 5  74  4        20   7 2       22  -900     75      78
 5  75  4        50   6 4       24  -100             76
 5  76  4        70   7 2       22191000    576  77  77
 5 576  4        70   7 1       24  1000     77
 5  77  4        30   6 4       24  1000             78
 5  78  4        15   7 1           -200     80      79
 5  79  4        20   7 2       22  1000
 5  80  4        30   7 2           -300     82      81
 5  81  4        20   7 2       22  1000             87
 5  87  4    26                     1000                        100
 5  82  4        15   7 1           -200     84      83
```

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890
```

5	83	4		20	7	2			22	1000						
5	84	4		40	7	2				-300			85			
5	85	4		20	7	2			22	1000			92			
5	92	4	27							1000					100	
5	22	29		15	4	1										1
5	19	6											20			1
5	20	6		10	6	3			23	-417	4		21			1
5	21	6		20	6	1			22	1000						1
5	4	6		20	6	3			22	-500	26					1
5	26	6		20	6	2			22	-83						1
5	17	5		5	6	1			20							1
5	9	7											10			1
5	10	7		20	9	2				19221000	11					1
5	11	7		15	9	1			21	1000						1
5	29	10		20	6	4			25	1000			30			1
5	30	10		40	6	3				1000			31			1
5	31	10								-500	34	33	32			1
5	32	10								1000			36			1
5	36	10		80	2	2			19	1000	37	33	33			1
5	37	10		60	3	2	6	4		1000		33	33			1
5	34	10								-500			35			1
5	35	10								1000			38			1
5	38	10		60	5	2				1000	39	33	33			1
5	39	10		70	7	2	6	4		1000		33	33			1
5	33	10		20	6	4			25	1000						1
5	101	8								59			102	38		
5	102	8		8	15	2				15	103					
5	103	8		16	15	1				29	104					
5	104	8		20	15	1				118	105					
5	105	8		18	15	1				-603	106					
5	106	8		58	12	1				-30	107		110			
5	107	8		22	15	1				-336	108		110			
5	108	8		24	16	1				-31			110			
5	110	8								-629	112					
5	112	8	33							-37	116				100	
5	116	8	31							-74	120				100	
5	120	8	32							-37	124				100	
5	124	8	34							-223					100	
5	127	9								13			128	52		
5	128	9		20	13	2				868	129					
5	129	9		26	13	2				316	130					
5	130	9		28	13	1				368	131					
5	131	9		28	13	1				-73	132					
5	132	9		42	17	1				-218	133					
5	133	9		32	13	1				-709			135			
5	135	9								-259	137					
5	137	9	35							-593	143				100	

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


 5 143  9    36                    -148                         100
 5 146  9                            48             147   36
 5 147  9         8  13 1           185     148
 5 148  9        20  13 2            46     149
 5 149  9        28  13 1           169     150
 5 150  9         8  13 1           182     151
 5 151  9        28  13 1          -739     152
 5 152  9        28  13 1          -261             154
 5 154  9                          -118     156
 5 156  9    37                    -235     160                 100
 5 160  9    38                    -647                         100
 5 165 12                            77             166   44
 5 166 12        10  14 1           172     167
 5 167 12        14  14 1           276     168
 5 168 12        26  14 1            69     169
 5 169 12        30  14 1          -569     170
 5 170 12        26  14 1           -35     171
 5 171 12        42  17 1           -34     172
 5 172 12    39  28  14 1          -362                         100
 5 178 13                            25             179   85
 5 179 13         4  12 1           310     180
 5 180 13         6  12 1           103     181
 5 181 13        40  12 1           379     182
 5 182 13        34  12 1          -448     183
 5 183 13        32  12 1           -69     184
 5 184 13    40  48  12 1          -483                          93
 7  1   1710000        1910000         910000
 8  1   33    8 180  15 1
 8  1   31    8  90  15 1
 8  1   32    8 270  15 1
 8  1   34    8 150  15 1
 8  1   36   11  36  11 1
 8  1   37   11  44  11 1
 8  2   26    4        -2   88
 8  2   27    4        -2   93
 8  2   28    3        -2   70
 8  2   29    1        -2   48
 8  2   30    2        -2   59
 8  2   35   14        -2  139             38   11        -2  162
 8  2   39   11        -2  175             40   14        -2  190
 8  3   88   89  10   7 1           0      89   90   20  7 1           50
 8  3   90       50   7 2          50
 8  3   93   94  10   7 1           0      94   95   30  7 1           21
 8  3   95       40   7 2          79
 8  3   48   50  10   2 1           0      50   49   20  2 1           13
 8  3   49       50   2 2          87
 8  3   59   60  10   3 1           0      60   61   50  3 1           70
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890



 8  3   61       20   3 1          30
 8  3   70   71  10   5 1           0      71   72  40   5 2          80
 8  3   72       20   5 2          20
 8  3  139  140 108  10 1           0     140  141  96  10 1          56
 8  3  141       70  10 1          44
 8  3  162  163  80  11 1           0     163  164  80  11 1          24
 8  3  164      108  11 1          76
 8  3  175  176 138  11 1           0     176  177 158  11 1          57
 8  3  177      116  11 1          43
 8  3  190  191 236  10 1           0     191  192 192  10 1          11
 8  3  192      214  10 1          89
12       1    1    1    1
12       1    2    1    2
12       1    3    1    3
13  1   1   1    1 1
13  2   2   1    1 1
13  3   3   1    1 1                20    2 4 23    8 5
14  1  1     11
14  2  1     11                20     22       8 2
14  3  1     11                20     22       8 2
15  1    1              1   22    3  120  120
16  1 1     900            120            100     60  0
16  1 2     900            120            100     60  0
16  1 3     900            120              0     60  0
17  1    1    1                                   32750
17  3    1    0    0    1    1
20  1  1     72
21  1    23009915048       1 2    33009915048       2 2
21  1    43009915048      29 1    73009915048       4 3
21  1    53009915048       3 2    63009915048       6 4
21  1    83009915048      28 5    93009915048       7 3
21  1   103009915048      14 1   113009915048      11 1
21  1   123009915048      13 1   133009915048       9 2
21  1   143009915048      12 2   153009915048       8 2
21  1   163009915048      16 1   173009915048      15 1
22  1   18 9999    2   19 9999    10   20 9999    5   21 9999    3
22  1   22 9999    1   23 9999     6   24 9999    4   25 9999   10
23      26 99    0 0  100   70   27 99    0 0  100   30
23      28 99    0 0  100   50   29 99    0 0  100   25
23      30 99    0 0  100   50
23      31 99    0 0  100    0   32 99    0 0  100    0
23      33 99    0 0  100    0   34 99    0 0  100    0
23      35 99    0 0  100   10   36 99    0 0  100  100
23      37 99    0 0  100    0   38 99    0 0  100    5
23      39 99    0 0  100   16   40 99    0 0  100   10
24  1    120000    220000    320000
25  1    1 1000    2 1000    3 1000
```

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         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890


27       132750
29  1    1    1    6   29    0   40   51   62   73  101  127  146
29  1    1    2  165  178    0    7    0    5    0   26    0    0
33  1    3 10        4 10
34  1    1   40    2
41  1 1    72
99
```

CONTROL TABLE

INDEX	TASK NAME	TASK ID	DEC CLK	SEL MODE	PARAM	NEXT INDEX	ALT INDEX
1	FDEPOT	38		D	0		
2	FPEFLT	10		C	0	3	
3	LANCH1	23		D	0	4	
4	SORTIE	54	-	S	0	5	
5	FOSTF1	39		D	0	6	7
6	CALLS1	40		C	0		
7	REFUEL	47		SU	3	8	
8	DUMY	144		LE	3	9	
9	DUMY	144		AD	3		
10	MFREFT	27		D	0		11
11	SERVHY	53		D	0		
12	DUMY	144		GE	2	16	13
13	DUMY	144		LS	2	14	
14	DUMY	144		AD	2	15	
15	LOADSB	26		D	0	16	
16	FREFLT	10		C	0	17	
17	LANCH2	24		D	0	18	
18	SORTIE	54	-	S	0	19	
19	EOR	5		SU	2	20	
20	FOSTF2	40		D	0	22	21
21	REFUEL	47		SU	3	8	
22	CALLS1	40		C	0		
23	FREFLT	10		C	0	24	
24	LANCH3	25		D	0	25	
25	SORTIE	54	-	S	0	26	
26	POSTF3	41		D	0	28	27
27	REFUEL	47		SU	3	8	
28	CALLS1	40		C	0		
29	JTOW	16		D	0	30	
30	JWASH	17		D	0	31	
31	DUMY	144		E	50000	32	34
32	CALLP1	[illegible]		C	0	33	
33	JTOW	16		D	0		
34	DUMY	144		E	50000	35	
35	CALLP2	38		C	0	33	
36	H52000	13		D	0		37
37	H72000	14		D	0		
38	H45000	12		D	0		39
39	H13000	11		D	0		
40	DUMY	144		F	0	41	51
41	T52000	58		D	0	42	
42	M52000	31		E	25000	44	43
43	R52100	51		E	75000	45	
44	V52000	63		D	0		
45	V52000	63		D	0	46	
46	G52100	9		R	0	48	47
47	Q52100	45		I	0		

INDEX	TASK NAME	TASK ID	DEC CLK	SEL MODE	PARAM	NEXT INDEX	ALT INDEX
97	DNRACK	3		D	0		
98	DUMY	144		D	0		
99	DNBOMB	4		D	0		
100	DNBOMB	4		D	0	97	
101	DUMY	144		F	0	102	127
102	V42C00	124		A	1500		103
103	T42C00	119		A	2900		104
104	X42C00	139		A	11800		105
105	M42C00	89		E	60300		108
106	R42C00	111		E	3000	109	107
107	R42C01	112		E	33600	109	108
108	R42C02	113		E	3100	109	
109	SHOP	118		D	0	110	
110	JNSH2P	83		E	62900		111
111	JDUMY1	82		E	3700	112	115
112	Q42CH4	103		D	0		113
113	G42CH4	72		D	0	114	
114	W42CH4	132		D	0		
115	JDUMY1	82		E	7400	116	119
116	Q42CHA	101		D	0		117
117	G42CHA	70		D	0	116	
118	W42CHA	130		D	0		
119	JDUMY1	82		E	3700	120	123
120	Q42CHG	102		I	0		121
121	G42CHG	71		D	0	122	
122	W42CHG	131		D	0		
123	JDUMY1	82		E	22300	124	
124	Q42CJD	104		D	0		125
125	G42CJD	73		D	0	126	
126	W42CJD	133		D	0		
127	DUMY	144		F	0	128	146
128	V51E00	125		A	86800		129
129	T51E00	120		A	31600		130
130	X51E00	140		A	36800		131
131	M51E00	90		E	7300		132
132	M51E01	91		E	21800		133
133	R51E00	114		E	70900	134	
134	SHOP	118		D	0	135	
135	JNSH2P	83		E	25900		136
136	JDUMY1	82		E	59300	137	142
137	Q51EA0	105		I	0		138
138	G51EA0	74		D	0	139	
139	N51EA0	96		E	10000	1	140
140	W51EA0	134		E	50000		141
141	K51EA0	85		E	40000		
142	JDUMY	82		E	14800	143	
143	Q51ED0	106		I	0		144

INDEX	TASK NAME	TASK ID	DEC CLK	SEL MODE	PARAM	NEXT INDEX	ALT INDEX
48	N52100	38		E	25000	1	49
49	W52100	68		E	65000		50
50	K52100	21		E	10000		
51	DUMY	144		F	0	52	62
52	T72000	59		D	0	53	
53	M72000	32		E	30000	54	55
54	V72000	64		D	0		
55	R72100	52		E	70000	56	
56	V72000	64		D	0	57	
57	G72100	10		D	0	59	58
58	Q72100	46		I	0		
59	N72100	37		E	50000	1	60
60	W72100	69		E	35000		61
61	K72100	22		E	15000		
62	DUMY	144		F	0	63	73
63	T45000	57		D	0	64	
64	M45000	30		E	40000	66	65
65	R45100	50		E	60000	67	
66	V45000	62		D	0		
67	G45100	8		D	0	70	68
68	Q45100	44		I	0	69	
69	V45000	62		D	0		
70	N45100	35		E	50000	1	71
71	W45100	67		E	40000		72
72	K45100	23		E	10000		
73	DUMY	144		F	0	74	101
74	T13000	56		E	90000	78	75
75	UPJACK	60		E	10000	76	
76	TSHOOT	55		D	0	77	
77	DNJACK	2		D	0	78	
78	M13A00	28		E	20000	79	80
79	V13000	61		D	0		
80	R13A00	48		E	30000	81	82
81	V13000	61		D	0	86	
82	M13B00	29		E	20000	83	84
83	V13000	61		D	0		
84	R13B00	49		E	30000	85	
85	V13000	61		D	0	91	
86	G13A00	6		D	0	88	87
87	Q13A00	42		I	0		
88	N13A00	33		E	70000	1	89
89	K13A00	18		E	15000		90
90	W13A00	65		E	15000		
91	G13B00	7		D	0	93	92
92	Q13B00	43		I	0		
93	N13B00	34		E	30000	1	94
94	K13B00	19		E	15000		95
95	W13B00	66		E	55000		
96	INRACK	15		D	0		

INDEX	TASK NAME	TASK ID	DEC CLK	SEL MODE	PARAM	NEXT INDEX	ALT INDEX
144	G51ED0	75		D	0	145	
145	N51ED0	97		D	0	1	
146	DUMY	144		F	0	147	165
147	V55A01	126		A	13500		148
148	T55A01	121		A	4600		149
149	X55A00	141		A	16900	150	151
150	V55A03	127		A	18200		
151	M55A01	92		E	73900		152
152	R55A00	115		E	26100	153	
153	SHOP	118		D	0	154	
154	JNSH2P	83		E	11800		155
155	JDUMY1	82		E	23500	156	159
156	Q55AB0	107		D	0		157
157	G55AB0	76		D	0	158	
158	W55AB0	135		D	0		
159	JDUMY1	82		E	64700	160	
160	Q55AE0	108		I	0		161
161	G55AE0	77		D	0	162	
162	N55AE0	98		E	4600	1	163
163	K55AE0	86		E	22700		164
164	W55AE0	130		E	72700		
165	DUMY	144		F	0	166	178
166	V71D00	128		A	17200		167
167	T71D00	122		A	27600		168
168	X71D00	142		A	6900		169
169	H71D00	60		E	56900		170
170	M71D00	93		E	3500		171
171	M71D01	94		E	3400		172
172	R71D00	116		E	36200	173	
173	Q71DA0	109		I	0		174
174	G71DA0	78		D	0	175	
175	N71DA0	99		E	15900	1	176
176	W71DA0	137		E	47700		177
177	K71DA0	87		E	36400		
178	DUMY	144		F	0	179	
179	V74E00	129		A	31000		180
180	T74E00	123		A	10300		181
181	X74E00	143		A	37900		182
182	H74E00	81		E	44800		183
183	M74E00	95		E	6900		184
184	R74E00	117		E	48300	185	
185	SHOP	118		D	0	186	
186	JNSH2P	83		E	7100		187
187	JDUMY1	82		E	92900	188	
188	Q74EB0	110		D	0		189
189	G74EB0	79		D	0	190	
190	N74EB0	100		E	10400	1	191
191	K74EB0	88		E	10300		192
192	W74EB0	138		E	79300		

RESOURCES

WITH MAX.AUTHORIZED AND MAX.USED INFO, AND A FLAG THAT = '+' IF MAXM AUTH IS LESS THAN MAXM USED
A NEGATIVE SIGN IN THE QPA FIELD MEANS THAT THE PART WAS USED ON BOTH I AND NON-I TASKS

INDEX NO.	RESOURCE NAME	REPRT COLM	MAXM AUTH	MAXM USED	FLAG	QPA
1	F-38	1	72	0		0
2	325X0	1	200	2		0
3	328X1	2	200	2		0
4	423X3	3	200	1		0
5	423X4	4	200	2		0
6	431X1	5	200	4		0
7	432L4	6	200	3		0
8	462X0	7	200	5		0
9	462X1	8	200	2		0
10	326S4	9	200	1		0
11	326S5	10	200	1		0
12	326X6	11	200	1		0
13	326X7	12	200	2		0
14	326X8	13	200	2		0

INDEX NO.	RESOURCE NAME	REPRT COLM	MAXM AUTH	MAXM USED	FLAG	QPA
15	423X0	14	200	2		0
16	423X1	15	200	1		0
17	427X5	16	200	1		0
18	ARCON	1	100	1		0
19	B-4	2	100	1		0
20	GCART	3	100	1		0
21	HCART	4	100	1		0
22	MD3	5	100	1		0
23	MJ2	6	100	1		0
24	TJACK	7	100	4		0
25	TOBAR	8	100	1		0
26	13A00	1	100	1		1
27	13B00	2	100	1		1
28	45100	3	100	1		1

INDEX NO.	RESOURCE NAME	REPRT COLM	MAXM AUTH	MAXM USED	FLAG	QPA
29	52100	4	100	1		1
30	72100	5	100	1		1
31	42CHA	6	100	1		1
32	42CHG	7	100	1		1
33	42CH4	8	100	1		1
34	42CJD	9	100	1		1
35	51EA0	10	100	1		1
36	51ED0	11	100	1		1
37	55AB0	12	100	1		1
38	55AE0	13	100	1		1
39	71DA0	14	100	1		1
40	74EB0	15	100	1		1
41	BLANK	16	9999	0		0

AFSC/TSAR Shop Dictionary

AFSC	Shop Number
325X0	1
328X1	2
423X4	3
432L4	4
431X1	6
462X1	7
423X0	8
326X7	9
326S5	11
326X8	12
326X6	13
326S4	14
427X5	15
423X1	16
462X0	28
423X3	29

Appendix D: Flying Schedules

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         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890123456

**********************  LCOM Flying Schedules  *************************

                                       TDSR 1

     60 F-36   THESIS PROBLEM SR = 1.0
 20 1      1  0530 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  0530 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  0630 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0630 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  0730 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0730 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0830 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  0930 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1030 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1030 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1130 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1230 F-36   FERRY  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1230 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1230 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1330 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1430 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1430 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1630 F-36   FERRY  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1630 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1630 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  1730 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1730 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1930 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2  1930 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  2030 F-36   FERRY  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  2030 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999


                                       TDSR 2

     60 F-36   THESIS PROBLEM SR = 2.0
 20 1      1  0530 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3  0530 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0630 F-36   FERRY  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3  0630 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3  0630 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3  0730 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3  0730 F-36   SMTBM  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0830 F-36   FERRY  1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1  0830 F-36   CLSPT  1 2 0  1.5         C 4.0  2.0  1  1  999
```

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         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234


 20 1      3 0930 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0930 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1030 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1030 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1030 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1130 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1230 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1230 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1330 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1430 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1430 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1430 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1530 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1630 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1630 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1630 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1730 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1730 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1830 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1930 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1930 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 2030 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 2030 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
```

TDSR 3

```
     60 F-36 THESIS PROBLEM SR = 3.0
 20 1      4 0530 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0530 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      2 0630 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0630 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0630 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0730 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0730 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 0830 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      4 0830 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0830 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0930 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 0930 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1030 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1030 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1030 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      4 1130 F-36   CLSPT   1 2 0  1.5         C 4.0  2 0  1  1  999
 20 1      3 1130 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      1 1230 F-36   FERRY   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1230 F-36   CLSPT   1 2 0  1.5         C 4.0  2.0  1  1  999
 20 1      3 1230 F-36   SMTBM   1 2 0  1.5         C 4.0  2.0  1  1  999
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         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890123 4

 20 1      3  1330 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      1  1430 F-36   FERRY  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      4  1430 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1430 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1530 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1530 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      1  1630 F-36   FERRY  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1630 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1630 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      4  1730 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1730 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      1  1830 F-36   FERRY  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1830 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1830 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1930 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  1930 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      1  2030 F-36   FERRY  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      4  2030 F-36   CLSPT  1 2 0   1.5          C 4.0   2.0  1  1  999
 20 1      3  2030 F-36   SMTBM  1 2 0   1.5          C 4.0   2.0  1  1  999
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         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234

**********************  TSAR Flying Schedules  ************************

                                TDSR 1

         ***  SR = 1 FORMATTED INPUT DATA  ***
50  1    1    1    2    1         2    1   18             530    1
50  2    1    1    3    1         2    1   18             530    2
50  3    1    1    2    1         2    1   18             630    2
50  4    1    1    3    1         2    1   18             630    1
50  5    1    1    2    1         2    1   18             730    2
50  6    1    1    3    1         2    1   18             730    1
50  7    1    1    2    1         2    1   18             830    1
50  8    1    1    3    1         2    1   18             930    2
50  9    1    1    2    1         2    1   18            1030    2
50 10    1    1    3    1         2    1   18            1030    1
50 11    1    1    2    1         2    1   18            1130    1
50 12    1    1    1    1         2    1   18            1230    1
50 13    1    1    2    1         2    1   18            1230    1
50 14    1    1    3    1         2    1   18            1230    1
50 15    1    1    2    1         2    1   18            1330    2
50 16    1    1    2    1         2    1   18            1430    1
50 17    1    1    3    1         2    1   18            1430    1
50 18    1    1    1    1         2    1   18            1630    1
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         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234


50 19    1    1    2    1         2    1   18           1630    1
50 20    1    1    3    1         2    1   18           1630    2
50 21    1    1    2    1         2    1   18           1730    1
50 22    1    1    3    1         2    1   18           1730    2
50 23    1    1    2    1         2    1   18           1930    2
50 24    1    1    3    1         2    1   18           1930    2
50 25    1    1    1    1         2    1   18           2030    1
50 26    1    1    2    1         2    1   18           2030    1
99 61
```

TDSR 2

```
         ***  SR = 2 FORMATTED INPUT DATA  ***
50  1    1    1    2    1         2    1   18            530    1
50  2    1    1    3    1         2    1   18            530    3
50  3    1    1    1    1         2    1   18            630    1
50  4    1    1    2    1         2    1   18            630    3
50  5    1    1    3    1         2    1   18            630    3
50  6    1    1    2    1         2    1   18            730    3
50  7    1    1    3    1         2    1   18            730    3
50  8    1    1    1    1         2    1   18            830    1
50  9    1    1    2    1         2    1   18            830    1
50 10    1    1    2    1         2    1   18            930    3
50 11    1    1    3    1         2    1   18            930    3
50 12    1    1    1    1         2    1   18           1030    1
50 13    1    1    2    1         2    1   18           1030    3
50 14    1    1    3    1         2    1   18           1030    3
50 15    1    1    2    1         2    1   18           1130    1
50 16    1    1    2    1         2    1   18           1230    3
50 17    1    1    3    1         2    1   18           1230    3
50 18    1    1    2    1         2    1   18           1330    3
50 19    1    1    1    1         2    1   18           1430    1
50 20    1    1    2    1         2    1   18           1430    1
50 21    1    1    3    1         2    1   18           1430    3
50 22    1    1    2    1         2    1   18           1530    3
50 23    1    1    1    1         2    1   18           1630    1
50 24    1    1    2    1         2    1   18           1630    3
50 25    1    1    3    1         2    1   18           1630    3
50 26    1    1    2    1         2    1   18           1730    1
50 27    1    1    3    1         2    1   18           1730    3
50 28    1    1    2    1         2    1   18           1830    3
50 29    1    1    2    1         2    1   18           1930    3
50 30    1    1    3    1         2    1   18           1930    3
50 31    1    1    1    1         2    1   18           2030    1
50 32    1    1    2    1         2    1   18           2030    1
99 61
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         1         2         3         4         5         6         7
12345678901234567890123456789012345678901234567890123456789012345678901234


                                     TDSR 3

          ***  SR = 3 FORMATTED INPUT DATA  ***
50  1    1    1    2    1         2    1   18            530    4
50  2    1    1    3    1         2    1   18            530    3
50  3    1    1    1    1         2    1   18            630    2
50  4    1    1    2    1         2    1   18            630    3
50  5    1    1    3    1         2    1   18            630    3
50  6    1    1    2    1         2    1   18            730    3
50  7    1    1    3    1         2    1   18            730    3
50  8    1    1    1    1         2    1   18            830    1
50  9    1    1    2    1         2    1   18            830    4
50 10    1    1    3    1         2    1   18            830    3
50 11    1    1    2    1         2    1   18            930    3
50 12    1    1    3    1         2    1   18            930    3
50 13    1    1    1    1         2    1   18           1030    1
50 14    1    1    2    1         2    1   18           1030    3
50 15    1    1    3    1         2    1   18           1030    3
50 16    1    1    2    1         2    1   18           1130    4
50 17    1    1    3    1         2    1   18           1130    3
50 18    1    1    1    1         2    1   18           1230    1
50 19    1    1    2    1         2    1   18           1230    3
50 20    1    1    3    1         2    1   18           1230    3
50 21    1    1    2    1         2    1   18           1330    3
50 22    1    1    1    1         2    1   18           1430    1
50 23    1    1    2    1         2    1   18           1430    4
50 24    1    1    3    1         2    1   18           1430    3
50 25    1    1    2    1         2    1   18           1530    3
50 26    1    1    3    1         2    1   18           1530    3
50 27    1    1    1    1         2    1   18           1630    1
50 28    1    1    2    1         2    1   18           1630    3
50 29    1    1    3    1         2    1   18           1630    3
50 30    1    1    2    1         2    1   18           1730    4
50 31    1    1    3    1         2    1   18           1730    3
50 32    1    1    1    1         2    1   18           1830    1
50 33    1    1    2    1         2    1   18           1830    3
50 34    1    1    3    1         2    1   18           1830    3
50 35    1    1    2    1         2    1   18           1930    3
50 36    1    1    3    1         2    1   18           1930    3
50 37    1    1    1    1         2    1   18           2030    1
50 38    1    1    2    1         2    1   18           2030    4
50 39    1    1    3    1         2    1   18           2030    3
99 61
```

Appendix E: Simulation Output

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
1	1	325X0	LCOM	4320	3599	0.833102
2	1	325X0	LCOM	4320	3738	0.865278
3	1	325X0	LCOM	4320	3928	0.909259
4	1	325X0	LCOM	4320	3994	0.924537
5	1	325X0	LCOM	4320	4206	0.973611
6	1	325X0	LCOM	4320	3709	0.858565
7	1	325X0	LCOM	4320	3662	0.847685
8	1	325X0	LCOM	4320	3718	0.860648
9	1	325X0	LCOM	4320	3579	0.828472
10	1	325X0	LCOM	4320	3687	0.853472
11	1	325X0	TSAR	4304	3930	0.913104
12	1	325X0	TSAR	4302	3450	0.801953
13	1	325X0	TSAR	4307	3530	0.819596
14	1	325X0	TSAR	4306	3800	0.882490
15	1	325X0	TSAR	4306	3400	0.789596
16	1	325X0	TSAR	4306	3860	0.896424
17	1	325X0	TSAR	4305	3930	0.912892
18	1	325X0	TSAR	4305	3850	0.894309
19	1	325X0	TSAR	4307	3740	0.868354
20	1	325X0	TSAR	4304	3840	0.892193
21	1	326S4	LCOM	4320	704	0.162963
22	1	326S4	LCOM	4320	736	0.170370
23	1	326S4	LCOM	4320	780	0.180556
24	1	326S4	LCOM	4320	617	0.142824
25	1	326S4	LCOM	4320	444	0.102778
26	1	326S4	LCOM	4320	590	0.136574
27	1	326S4	LCOM	4320	584	0.135185
28	1	326S4	LCOM	4320	652	0.150926
29	1	326S4	LCOM	4320	516	0.119444
30	1	326S4	LCOM	4320	917	0.212269
31	1	326S4	TSAR	4304	660	0.153346
32	1	326S4	TSAR	4302	680	0.158066
33	1	326S4	TSAR	4307	590	0.136986
34	1	326S4	TSAR	4306	540	0.125406
35	1	326S4	TSAR	4306	640	0.148630
36	1	326S4	TSAR	4306	700	0.162564
37	1	326S4	TSAR	4305	660	0.153310
38	1	326S4	TSAR	4305	570	0.132404
39	1	326S4	TSAR	4307	510	0.118412
40	1	326S4	TSAR	4304	550	0.127788
41	1	326S5	LCOM	4320	1007	0.233102
42	1	326S5	LCOM	4320	1106	0.256019
43	1	326S5	LCOM	4320	1002	0.231944
44	1	326S5	LCOM	4320	1057	0.244676
45	1	326S5	LCOM	4320	969	0.224306
46	1	326S5	LCOM	4320	909	0.210417
47	1	326S5	LCOM	4320	980	0.226852

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
48	1	326S5	LCOM	4320	1035	0.239583
49	1	326S5	LCOM	4320	1094	0.253241
50	1	326S5	LCOM	4320	1102	0.255093
51	1	326S5	TSAR	4304	930	0.216078
52	1	326S5	TSAR	4302	1050	0.244073
53	1	326S5	TSAR	4307	910	0.211284
54	1	326S5	TSAR	4306	1020	0.236879
55	1	326S5	TSAR	4306	1060	0.246168
56	1	326S5	TSAR	4306	890	0.206688
57	1	326S5	TSAR	4305	1030	0.239257
58	1	326S5	TSAR	4305	1160	0.269454
59	1	326S5	TSAR	4307	970	0.225215
60	1	326S5	TSAR	4304	1120	0.260223
61	1	326X6	LCOM	4320	340	0.078704
62	1	326X6	LCOM	4320	343	0.079398
63	1	326X6	LCOM	4320	390	0.090278
64	1	326X6	LCOM	4320	303	0.070139
65	1	326X6	LCOM	4320	258	0.059722
66	1	326X6	LCOM	4320	313	0.072454
67	1	326X6	LCOM	4320	299	0.069213
68	1	326X6	LCOM	4320	344	0.079630
69	1	326X6	LCOM	4320	325	0.075231
70	1	326X6	LCOM	4320	424	0.098148
71	1	326X6	TSAR	4304	320	0.074349
72	1	326X6	TSAR	4302	350	0.081358
73	1	326X6	TSAR	4307	340	0.078941
74	1	326X6	TSAR	4306	310	0.071993
75	1	326X6	TSAR	4306	340	0.078960
76	1	326X6	TSAR	4306	380	0.088249
77	1	326X6	TSAR	4305	300	0.069686
78	1	326X6	TSAR	4305	360	0.083624
79	1	326X6	TSAR	4307	320	0.074298
80	1	326X6	TSAR	4304	280	0.065056
81	1	326X7	LCOM	4320	581	0.134491
82	1	326X7	LCOM	4320	647	0.149769
83	1	326X7	LCOM	4320	652	0.150926
84	1	326X7	LCOM	4320	658	0.152315
85	1	326X7	LCOM	4320	669	0.154861
86	1	326X7	LCOM	4320	620	0.143519
87	1	326X7	LCOM	4320	632	0.146296
88	1	326X7	LCOM	4320	613	0.141898
89	1	326X7	LCOM	4320	598	0.138426
90	1	326X7	LCOM	4320	617	0.142824
91	1	326X7	TSAR	4304	690	0.160316
92	1	326X7	TSAR	4302	630	0.146444
93	1	326X7	TSAR	4307	590	0.136986
94	1	326X7	TSAR	4306	640	0.148630
95	1	326X7	TSAR	4306	620	0.143985
96	1	326X7	TSAR	4306	600	0.139340

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
97	1	326X7	TSAR	4305	640	0.148664
98	1	326X7	TSAR	4305	600	0.139373
99	1	326X7	TSAR	4307	600	0.139308
100	1	326X7	TSAR	4304	610	0.141729
101	1	326X8	LCOM	4320	585	0.135417
102	1	326X8	LCOM	4320	605	0.140046
103	1	326X8	LCOM	4320	551	0.127546
104	1	326X8	LCOM	4320	597	0.138194
105	1	326X8	LCOM	4320	582	0.134722
106	1	326X8	LCOM	4320	530	0.122685
107	1	326X8	LCOM	4320	587	0.135880
108	1	326X8	LCOM	4320	627	0.145139
109	1	326X8	LCOM	4320	627	0.145139
110	1	326X8	LCOM	4320	549	0.127083
111	1	326X8	TSAR	4304	530	0.123141
112	1	326X8	TSAR	4302	620	0.144119
113	1	326X8	TSAR	4307	560	0.130021
114	1	326X8	TSAR	4306	560	0.130051
115	1	326X8	TSAR	4306	620	0.143985
116	1	326X8	TSAR	4306	550	0.127729
117	1	326X8	TSAR	4305	570	0.132404
118	1	326X8	TSAR	4305	640	0.148664
119	1	326X8	TSAR	4307	600	0.139308
120	1	326X8	TSAR	4304	570	0.132435
121	1	328X1	LCOM	4320	3007	0.696065
122	1	328X1	LCOM	4320	3145	0.728009
123	1	328X1	LCOM	4320	3001	0.694676
124	1	328X1	LCOM	4320	2641	0.611343
125	1	328X1	LCOM	4320	2734	0.632870
126	1	328X1	LCOM	4320	2728	0.631481
127	1	328X1	LCOM	4320	3000	0.694444
128	1	328X1	LCOM	4320	3098	0.717130
129	1	328X1	LCOM	4320	2959	0.684954
130	1	328X1	LCOM	4320	2761	0.639120
131	1	328X1	TSAR	4304	2770	0.643587
132	1	328X1	TSAR	4302	2660	0.618317
133	1	328X1	TSAR	4307	2470	0.573485
134	1	328X1	TSAR	4306	2860	0.664190
135	1	328X1	TSAR	4306	2840	0.659545
136	1	328X1	TSAR	4306	2920	0.678124
137	1	328X1	TSAR	4305	2720	0.631823
138	1	328X1	TSAR	4305	3080	0.715447
139	1	328X1	TSAR	4307	2990	0.694219
140	1	328X1	TSAR	4304	2930	0.680762
141	1	423X0	LCOM	4320	500	0.115741
142	1	423X0	LCOM	4320	561	0.129861
143	1	423X0	LCOM	4320	553	0.128009
144	1	423X0	LCOM	4320	465	0.107639
145	1	423X0	LCOM	4320	480	0.111111

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
146	1	423X0	LCOM	4320	553	0.128009
147	1	423X0	LCOM	4320	551	0.127546
148	1	423X0	LCOM	4320	597	0.138194
149	1	423X0	LCOM	4320	627	0.145139
150	1	423X0	LCOM	4320	622	0.143981
151	1	423X0	TSAR	4304	590	0.137082
152	1	423X0	TSAR	4302	480	0.111576
153	1	423X0	TSAR	4307	520	0.120734
154	1	423X0	TSAR	4306	530	0.123084
155	1	423X0	TSAR	4306	630	0.146307
156	1	423X0	TSAR	4306	560	0.130051
157	1	423X0	TSAR	4305	500	0.116144
158	1	423X0	TSAR	4305	570	0.132404
159	1	423X0	TSAR	4307	570	0.132343
160	1	423X0	TSAR	4304	570	0.132435
161	1	423X1	LCOM	4320	11	0.002546
162	1	423X1	LCOM	4320	16	0.003704
163	1	423X1	LCOM	4320	7	0.00162
164	1	423X1	LCOM	4320	8	0.00185
165	1	423X1	LCOM	4320	7	0.00162
166	1	423X1	LCOM	4320	6	0.00139
167	1	423X1	LCOM	4320	12	0.00278
168	1	423X1	LCOM	4320	7	0.00162
169	1	423X1	LCOM	4320	10	0.00231
170	1	423X1	LCOM	4320	13	0.00301
171	1	423X1	TSAR	4304	0	0.00000
172	1	423X1	TSAR	4302	10	0.00232
173	1	423X1	TSAR	4307	10	0.00232
174	1	423X1	TSAR	4306	0	0.00000
175	1	423X1	TSAR	4306	10	0.00232
176	1	423X1	TSAR	4306	0	0.00000
177	1	423X1	TSAR	4305	0	0.00000
178	1	423X1	TSAR	4305	10	0.00232
179	1	423X1	TSAR	4307	10	0.00232
180	1	423X1	TSAR	4304	0	0.00000
181	1	423X3	LCOM	4320	3240	0.75000
182	1	423X3	LCOM	4320	3240	0.75000
183	1	423X3	LCOM	4320	3240	0.75000
184	1	423X3	LCOM	4320	3240	0.75000
185	1	423X3	LCOM	4320	3240	0.75000
186	1	423X3	LCOM	4320	3240	0.75000
187	1	423X3	LCOM	4320	3240	0.75000
188	1	423X3	LCOM	4320	3240	0.75000
189	1	423X3	LCOM	4320	3240	0.75000
190	1	423X3	LCOM	4320	3240	0.75000
191	1	423X3	TSAR	4301	3220	0.74814
192	1	423X3	TSAR	4302	3220	0.74849
193	1	423X3	TSAR	4307	3230	0.74994
194	1	423X3	TSAR	4306	3220	0.74779

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
195	1	423X3	TSAR	4306	3220	0.74779
196	1	423X3	TSAR	4306	3220	0.74779
197	1	423X3	TSAR	4305	3220	0.74797
198	1	423X3	TSAR	4305	3220	0.74797
199	1	423X3	TSAR	4307	3230	0.74994
200	1	423X3	TSAR	4304	3220	0.74814
201	1	423X4	LCOM	4320	5521	1.27801
202	1	423X4	LCOM	4320	5820	1.34722
203	1	423X4	LCOM	4320	5966	1.38102
204	1	423X4	LCOM	4320	5657	1.30949
205	1	423X4	LCOM	4320	5725	1.32523
206	1	423X4	LCOM	4320	5423	1.25532
207	1	423X4	LCOM	4320	6038	1.39769
208	1	423X4	LCOM	4320	5757	1.33264
209	1	423X4	LCOM	4320	5385	1.24653
210	1	423X4	LCOM	4320	5455	1.26273
211	1	423X4	TSAR	4304	6140	1.42658
212	1	423X4	TSAR	4302	5890	1.36913
213	1	423X4	TSAR	4307	5430	1.26074
214	1	423X4	TSAR	4306	5470	1.27032
215	1	423X4	TSAR	4306	5300	1.23084
216	1	423X4	TSAR	4306	5680	1.31909
217	1	423X4	TSAR	4305	5970	1.38676
218	1	423X4	TSAR	4305	5680	1.31940
219	1	423X4	TSAR	4307	5450	1.26538
220	1	423X4	TSAR	4304	5740	1.33364
221	1	427X5	LCOM	4320	48	0.01111
222	1	427X5	LCOM	4320	52	0.01204
223	1	427X5	LCOM	4320	57	0.01319
224	1	427X5	LCOM	4320	38	0.00880
225	1	427X5	LCOM	4320	44	0.01019
226	1	427X5	LCOM	4320	55	0.01273
227	1	427X5	LCOM	4320	55	0.01273
228	1	427X5	LCOM	4320	38	0.00880
229	1	427X5	LCOM	4320	39	0.00903
230	1	427X5	LCOM	4320	52	0.01204
231	1	427X5	TSAR	4304	40	0.00929
232	1	427X5	TSAR	4302	30	0.00697
233	1	427X5	TSAR	4307	60	0.01393
234	1	427X5	TSAR	4306	30	0.00697
235	1	427X5	TSAR	4306	60	0.01393
236	1	427X5	TSAR	4306	30	0.00697
237	1	427X5	TSAR	4305	40	0.00929
238	1	427X5	TSAR	4305	40	0.00929
239	1	427X5	TSAR	4307	40	0.00929
240	1	427X5	TSAR	4304	30	0.00697
241	1	431X1	LCOM	4320	13116	3.03611
242	1	431X1	LCOM	4320	13036	3.01759
243	1	431X1	LCOM	4320	13052	3.02130

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
244	1	431X1	LCOM	4320	13004	3.01019
245	1	431X1	LCOM	4320	13020	3.01389
246	1	431X1	LCOM	4320	13020	3.01389
247	1	431X1	LCOM	4320	13180	3.05093
248	1	431X1	LCOM	4320	12972	3.00278
249	1	431X1	LCOM	4320	12988	3.00648
250	1	431X1	LCOM	4320	13036	3.01759
251	1	431X1	TSAR	4304	13080	3.03903
252	1	431X1	TSAR	4302	13110	3.04742
253	1	431X1	TSAR	4307	12920	2.99977
254	1	431X1	TSAR	4306	13030	3.02601
255	1	431X1	TSAR	4306	12970	3.01208
256	1	431X1	TSAR	4306	13090	3.03994
257	1	431X1	TSAR	4305	13020	3.02439
258	1	431X1	TSAR	4305	13220	3.07085
259	1	431X1	TSAR	4307	13090	3.03924
260	1	431X1	TSAR	4304	13040	3.02974
261	1	432L4	LCOM	4320	1546	0.35787
262	1	432L4	LCOM	4320	1484	0.34352
263	1	432L4	LCOM	4320	1650	0.38194
264	1	432L4	LCOM	4320	1413	0.32708
265	1	432L4	LCOM	4320	1484	0.34352
266	1	432L4	LCOM	4320	1519	0.35162
267	1	432L4	LCOM	4320	1765	0.40856
268	1	432L4	LCOM	4320	1244	0.28796
269	1	432L4	LCOM	4320	1521	0.35208
270	1	432L4	LCOM	4320	1558	0.36065
271	1	432L4	TSAR	4304	1700	0.39498
272	1	432L4	TSAR	4302	1590	0.36960
273	1	432L4	TSAR	4307	1300	0.30183
274	1	432L4	TSAR	4306	1470	0.34138
275	1	432L4	TSAR	4306	1330	0.30887
276	1	432L4	TSAR	4306	1540	0.35764
277	1	432L4	TSAR	4305	1400	0.32520
278	1	432L4	TSAR	4305	1490	0.34611
279	1	432L4	TSAR	4307	1440	0.33434
280	1	432L4	TSAR	4304	1530	0.35548
281	1	462X0	LCOM	4320	8807	2.03866
282	1	462X0	LCOM	4320	8792	2.03519
283	1	462X0	LCOM	4320	8792	2.03519
284	1	462X0	LCOM	4320	8807	2.03866
285	1	462X0	LCOM	4320	8787	2.03403
286	1	462X0	LCOM	4320	8802	2.03750
287	1	462X0	LCOM	4320	8797	2.03634
288	1	462X0	LCOM	4320	8797	2.03634
289	1	462X0	LCOM	4320	8797	2.03634
290	1	462X0	LCOM	4320	8807	2.03866
291	1	462X0	TSAR	4304	9060	2.10502
292	1	462X0	TSAR	4302	9050	2.10367

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
293	1	462X0	TSAR	4307	9060	2.10355
294	1	462X0	TSAR	4306	9040	2.09940
295	1	462X0	TSAR	4306	9060	2.10404
296	1	462X0	TSAR	4306	9070	2.10636
297	1	462X0	TSAR	4305	9060	2.10453
298	1	462X0	TSAR	4305	9060	2.10453
299	1	462X0	TSAR	4307	9050	2.10123
300	1	462X0	TSAR	4304	9050	2.10270
301	1	462X1	LCOM	4320	11880	2.75000
302	1	462X1	LCOM	4320	11880	2.75000
303	1	462X1	LCOM	4320	11880	2.75000
304	1	462X1	LCOM	4320	11880	2.75000
305	1	462X1	LCOM	4320	11880	2.75000
306	1	462X1	LCOM	4320	11880	2.75000
307	1	462X1	LCOM	4320	11880	2.75000
308	1	462X1	LCOM	4320	11880	2.75000
309	1	462X1	LCOM	4320	11880	2.75000
310	1	462X1	LCOM	4320	11880	2.75000
311	1	462X1	TSAR	4304	11810	2.74396
312	1	462X1	TSAR	4302	11810	2.74523
313	1	462X1	TSAR	4307	11830	2.74669
314	1	462X1	TSAR	4306	11820	2.74501
315	1	462X1	TSAR	4306	11820	2.74501
316	1	462X1	TSAR	4306	11820	2.74501
317	1	462X1	TSAR	4305	11820	2.74564
318	1	462X1	TSAR	4305	11810	2.74332
319	1	462X1	TSAR	4307	11820	2.74437
320	1	462X1	TSAR	4304	11810	2.74396
321	2	325X0	LCOM	8627	7693	0.89174
322	2	325X0	LCOM	8635	7626	0.88315
323	2	325X0	LCOM	8635	7148	0.82779
324	2	325X0	LCOM	8634	8070	0.93468
325	2	325X0	LCOM	8635	7930	0.918356
326	2	325X0	LCOM	8632	7663	0.887743
327	2	325X0	LCOM	8635	7317	0.847365
328	2	325X0	LCOM	8631	7316	0.847642
329	2	325X0	LCOM	8632	7462	0.864458
330	2	325X0	LCOM	8630	7754	0.898494
331	2	325X0	TSAR	8394	7170	0.854182
332	2	325X0	TSAR	8428	7210	0.855482
333	2	325X0	TSAR	8402	7600	0.904547
334	2	325X0	TSAR	8440	7620	0.902844
335	2	325X0	TSAR	8443	7280	0.862253
336	2	325X0	TSAR	8389	7440	0.886876
337	2	325X0	TSAR	8403	7160	0.852077
338	2	325X0	TSAR	8387	7330	0.873972
339	2	325X0	TSAR	8453	7520	0.889625
340	2	325X0	TSAR	8443	7530	0.891863
341	2	326S4	LCOM	8627	1335	0.154747

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
342	2	326S4	LCOM	8635	1258	0.145686
343	2	326S4	LCOM	8635	1217	0.140938
344	2	326S4	LCOM	8634	1296	0.150104
345	2	326S4	LCOM	8635	1091	0.126346
346	2	326S4	LCOM	8632	1144	0.132530
347	2	326S4	LCOM	8635	1075	0.124493
348	2	326S4	LCOM	8631	1223	0.141699
349	2	326S4	LCOM	8632	921	0.106696
350	2	326S4	LCOM	8630	1304	0.151101
351	2	326S4	TSAR	8394	1250	0.148916
352	2	326S4	TSAR	8428	1030	0.122212
353	2	326S4	TSAR	8402	1320	0.157105
354	2	326S4	TSAR	8440	1180	0.139810
355	2	326S4	TSAR	8443	1320	0.156343
356	2	326S4	TSAR	8389	1100	0.131124
357	2	326S4	TSAR	8403	1210	0.143996
358	2	326S4	TSAR	8387	1000	0.119232
359	2	326S4	TSAR	8453	920	0.108837
360	2	326S4	TSAR	8443	1190	0.140945
361	2	326S5	LCOM	8627	2116	0.245276
362	2	326S5	LCOM	8635	2032	0.235321
363	2	326S5	LCOM	8635	2160	0.250145
364	2	326S5	LCOM	8634	2131	0.246815
365	2	326S5	LCOM	8635	1858	0.215171
366	2	326S5	LCOM	8632	1969	0.228105
367	2	326S5	LCOM	8635	1961	0.227099
368	2	326S5	LCOM	8631	1959	0.226973
369	2	326S5	LCOM	8632	2203	0.255213
370	2	326S5	LCOM	8630	1998	0.231518
371	2	326S5	TSAR	8394	2250	0.268049
372	2	326S5	TSAR	8428	2060	0.244423
373	2	326S5	TSAR	8402	1970	0.234468
374	2	326S5	TSAR	8440	2020	0.239336
375	2	326S5	TSAR	8443	1850	0.219116
376	2	326S5	TSAR	8389	1830	0.218143
377	2	326S5	TSAR	8403	2140	0.254671
378	2	326S5	TSAR	8387	2250	0.268272
379	2	326S5	TSAR	8453	1930	0.228321
380	2	326S5	TSAR	8443	2110	0.249911
381	2	326X6	LCOM	8627	667	0.077315
382	2	326X6	LCOM	8635	650	0.075275
383	2	326X6	LCOM	8635	650	0.075275
384	2	326X6	LCOM	8634	644	0.074589
385	2	326X6	LCOM	8635	610	0.070643
386	2	326X6	LCOM	8632	653	0.075649
387	2	326X6	LCOM	8635	613	0.070990
388	2	326X6	LCOM	8631	607	0.070328
389	2	326X6	LCOM	8632	557	0.064527
390	2	326X6	LCOM	8630	738	0.085516

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
391	2	326X6	TSAR	8394	650	0.077436
392	2	326X6	TSAR	8428	600	0.071191
393	2	326X6	TSAR	8402	720	0.085694
394	2	326X6	TSAR	8440	710	0.084123
395	2	326X6	TSAR	8443	700	0.082909
396	2	326X6	TSAR	8389	660	0.078674
397	2	326X6	TSAR	8403	640	0.076163
398	2	326X6	TSAR	8387	680	0.081078
399	2	326X6	TSAR	8453	500	0.059151
400	2	326X6	TSAR	8443	640	0.075802
401	2	326X7	LCOM	8627	1184	0.137244
402	2	326X7	LCOM	8635	1233	0.142791
403	2	326X7	LCOM	8635	1254	0.145223
404	2	326X7	LCOM	8634	1215	0.140723
405	2	326X7	LCOM	8635	1183	0.137001
406	2	326X7	LCOM	8632	1248	0.144578
407	2	326X7	LCOM	8635	1223	0.141633
408	2	326X7	LCOM	8631	1156	0.133936
409	2	326X7	LCOM	8632	1239	0.143536
410	2	326X7	LCOM	8630	1161	0.134531
411	2	326X7	TSAR	8394	1300	0.154873
412	2	326X7	TSAR	8428	1140	0.135263
413	2	326X7	TSAR	8402	1300	0.154725
414	2	326X7	TSAR	8440	1130	0.133886
415	2	326X7	TSAR	8443	1320	0.156343
416	2	326X7	TSAR	8389	1250	0.149005
417	2	326X7	TSAR	8403	1250	0.148756
418	2	326X7	TSAR	8387	1030	0.122809
419	2	326X7	TSAR	8453	1230	0.145510
420	2	326X7	TSAR	8443	1270	0.150420
421	2	326X8	LCOM	8627	1214	0.140721
422	2	326X8	LCOM	8635	1260	0.145918
423	2	326X8	LCOM	8635	1098	0.127157
424	2	326X8	LCOM	8634	1170	0.136206
425	2	326X8	LCOM	8635	1143	0.132368
426	2	326X8	LCOM	8632	1137	0.131719
427	2	326X8	LCOM	8635	1174	0.135958
428	2	326X8	LCOM	8631	1169	0.135442
429	2	326X8	LCOM	8632	1215	0.140755
430	2	326X8	LCOM	8630	1143	0.132445
431	2	326X8	TSAR	8394	1160	0.138194
432	2	326X8	TSAR	8428	1160	0.137636
433	2	326X8	TSAR	8402	1100	0.130921
434	2	326X8	TSAR	8440	1150	0.136256
435	2	326X8	TSAR	8443	1110	0.131470
436	2	326X8	TSAR	8389	1030	0.122780
437	2	326X8	TSAR	8403	1210	0.143996
438	2	326X8	TSAR	8387	1220	0.145463
439	2	326X8	TSAR	8453	1110	0.131314

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
440	2	326X8	TSAR	8443	1200	0.142130
441	2	328X1	LCOM	8627	5656	0.655616
442	2	328X1	LCOM	8635	6497	0.752403
443	2	328X1	LCOM	8635	5607	0.649334
444	2	328X1	LCOM	8634	5535	0.641070
445	2	328X1	LCOM	8635	5991	0.693804
446	2	328X1	LCOM	8632	5582	0.646664
447	2	328X1	LCOM	8635	5948	0.688825
448	2	328X1	LCOM	8631	6283	0.727957
449	2	328X1	LCOM	8632	5694	0.659639
450	2	328X1	LCOM	8630	5512	0.638702
451	2	328X1	TSAR	8394	6050	0.720753
452	2	328X1	TSAR	8428	5740	0.681063
453	2	328X1	TSAR	8402	5970	0.710545
454	2	328X1	TSAR	8440	5730	0.678910
455	2	328X1	TSAR	8443	5640	0.668009
456	2	328X1	TSAR	8389	5800	0.691382
457	2	328X1	TSAR	8403	5470	0.650958
458	2	328X1	TSAR	8387	5810	0.692739
459	2	328X1	TSAR	8453	5710	0.675500
460	2	328X1	TSAR	8443	5590	0.662087
461	2	423X0	LCOM	8627	1119	0.129709
462	2	423X0	LCOM	8635	1141	0.132137
463	2	423X0	LCOM	8635	1134	0.131326
464	2	423X0	LCOM	8634	1100	0.127403
465	2	423X0	LCOM	8635	1081	0.125188
466	2	423X0	LCOM	8632	1164	0.134847
467	2	423X0	LCOM	8635	1021	0.118240
468	2	423X0	LCOM	8631	1082	0.125362
469	2	423X0	LCOM	8632	1100	0.127433
470	2	423X0	LCOM	8630	1017	0.117845
471	2	423X0	TSAR	8394	1140	0.135811
472	2	423X0	TSAR	8428	1220	0.144756
473	2	423X0	TSAR	8402	990	0.117829
474	2	423X0	TSAR	8440	1000	0.118483
475	2	423X0	TSAR	8443	1250	0.148052
476	2	423X0	TSAR	8389	1040	0.123972
477	2	423X0	TSAR	8403	970	0.115435
478	2	423X0	TSAR	8387	1080	0.128771
479	2	423X0	TSAR	8453	1050	0.124216
480	2	423X0	TSAR	8443	1000	0.118441
481	2	423X1	LCOM	8627	18	0.002086
482	2	423X1	LCOM	8635	14	0.001621
483	2	423X1	LCOM	8635	26	0.003011
484	2	423X1	LCOM	8634	13	0.001506
485	2	423X1	LCOM	8635	11	0.001274
486	2	423X1	LCOM	8632	20	0.002317
487	2	423X1	LCOM	8635	22	0.00255
488	2	423X1	LCOM	8631	23	0.00266

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
489	2	423X1	LCOM	8632	22	0.00255
490	2	423X1	LCOM	8630	11	0.00127
491	2	423X1	TSAR	8394	20	0.00238
492	2	423X1	TSAR	8428	10	0.00119
493	2	423X1	TSAR	8402	20	0.00238
494	2	423X1	TSAR	8440	10	0.00118
495	2	423X1	TSAR	8443	10	0.00118
496	2	423X1	TSAR	8389	10	0.00119
497	2	423X1	TSAR	8403	10	0.00119
498	2	423X1	TSAR	8387	20	0.00238
499	2	423X1	TSAR	8453	20	0.00237
500	2	423X1	TSAR	8443	10	0.00118
501	2	423X3	LCOM	8627	6470	0.74997
502	2	423X3	LCOM	8635	6476	0.74997
503	2	423X3	LCOM	8635	6476	0.74997
504	2	423X3	LCOM	8634	6475	0.74994
505	2	423X3	LCOM	8635	6476	0.74997
506	2	423X3	LCOM	8632	6474	0.75000
507	2	423X3	LCOM	8635	6476	0.74997
508	2	423X3	LCOM	8631	6473	0.74997
509	2	423X3	LCOM	8632	6474	0.75000
510	2	423X3	LCOM	8630	6472	0.74994
511	2	423X3	TSAR	8394	6290	0.74934
512	2	423X3	TSAR	8428	6320	0.74988
513	2	423X3	TSAR	8402	6300	0.74982
514	2	423X3	TSAR	8440	6330	0.75000
515	2	423X3	TSAR	8443	6330	0.74973
516	2	423X3	TSAR	8389	6290	0.74979
517	2	423X3	TSAR	8403	6300	0.74973
518	2	423X3	TSAR	8387	6290	0.74997
519	2	423X3	TSAR	8453	6330	0.74885
520	2	423X3	TSAR	8443	6330	0.74973
521	2	423X4	LCOM	8627	11238	1.30265
522	2	423X4	LCOM	8635	11605	1.34395
523	2	423X4	LCOM	8635	11070	1.28199
524	2	423X4	LCOM	8634	11764	1.36252
525	2	423X4	LCOM	8635	10945	1.26752
526	2	423X4	LCOM	8632	11640	1.34847
527	2	423X4	LCOM	8635	11439	1.32472
528	2	423X4	LCOM	8631	11110	1.28722
529	2	423X4	LCOM	8632	11166	1.29356
530	2	423X4	LCOM	8630	11185	1.29606
531	2	423X4	TSAR	8394	11160	1.32952
532	2	423X4	TSAR	8428	11290	1.33958
533	2	423X4	TSAR	8402	10970	1.30564
534	2	423X4	TSAR	8440	11480	1.36019
535	2	423X4	TSAR	8443	11410	1.35142
536	2	423X4	TSAR	8389	11060	1.31839
537	2	423X4	TSAR	8403	10710	1.27454

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
538	2	423X4	TSAR	8387	11760	1.40217
539	2	423X4	TSAR	8453	11560	1.36756
540	2	423X4	TSAR	8443	10920	1.29338
541	2	427X5	LCOM	8627	92	0.01066
542	2	427X5	LCOM	8635	101	0.01170
543	2	427X5	LCOM	8635	92	0.01065
544	2	427X5	LCOM	8634	90	0.01042
545	2	427X5	LCOM	8635	97	0.01123
546	2	427X5	LCOM	8632	105	0.01216
547	2	427X5	LCOM	8635	107	0.01239
548	2	427X5	LCOM	8631	109	0.01263
549	2	427X5	LCOM	8632	105	0.01216
550	2	427X5	LCOM	8630	86	0.00997
551	2	427X5	TSAR	8394	90	0.01072
552	2	427X5	TSAR	8428	80	0.00949
553	2	427X5	TSAR	8402	90	0.01071
554	2	427X5	TSAR	8440	80	0.00948
555	2	427X5	TSAR	8443	90	0.01066
556	2	427X5	TSAR	8389	90	0.01073
557	2	427X5	TSAR	8403	90	0.01071
558	2	427X5	TSAR	8387	70	0.00835
559	2	427X5	TSAR	8453	100	0.01183
560	2	427X5	TSAR	8443	90	0.01066
561	2	431X1	LCOM	8627	26171	3.03362
562	2	431X1	LCOM	8635	26233	3.03798
563	2	431X1	LCOM	8635	26089	3.02131
564	2	431X1	LCOM	8634	26182	3.03243
565	2	431X1	LCOM	8635	26025	3.01390
566	2	431X1	LCOM	8632	26219	3.03638
567	2	431X1	LCOM	8635	26101	3.02270
568	2	431X1	LCOM	8631	26088	3.02259
569	2	431X1	LCOM	8632	26080	3.02132
570	2	431X1	LCOM	8630	26075	3.02144
571	2	431X1	TSAR	8394	25590	3.04861
572	2	431X1	TSAR	8428	25810	3.06241
573	2	431X1	TSAR	8402	25620	3.04927
574	2	431X1	TSAR	8440	25560	3.02844
575	2	431X1	TSAR	8443	25680	3.04157
576	2	431X1	TSAR	8389	25650	3.05758
577	2	431X1	TSAR	8403	25360	3.01797
578	2	431X1	TSAR	8387	25460	3.03565
579	2	431X1	TSAR	8453	25550	3.02260
580	2	431X1	TSAR	8443	25690	3.04276
581	2	432L4	LCOM	8627	3010	0.34890
582	2	432L4	LCOM	8635	2983	0.34545
583	2	432L4	LCOM	8635	3077	0.35634
584	2	432L4	LCOM	8634	2823	0.32696
585	2	432L4	LCOM	8635	2978	0.34488
586	2	432L4	LCOM	8632	2998	0.34731

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
587	2	432L4	LCOM	8635	3074	0.35599
588	2	432L4	LCOM	8631	2812	0.32580
589	2	432L4	LCOM	8632	3108	0.36006
590	2	432L4	LCOM	8630	2997	0.34728
591	2	432L4	TSAR	8394	3130	0.37289
592	2	432L4	TSAR	8428	3190	0.37850
593	2	432L4	TSAR	8402	2930	0.34873
594	2	432L4	TSAR	8440	2720	0.32227
595	2	432L4	TSAR	8443	2970	0.35177
596	2	432L4	TSAR	8389	3250	0.38741
597	2	432L4	TSAR	8403	2950	0.35107
598	2	432L4	TSAR	8387	3010	0.35889
599	2	432L4	TSAR	8453	2690	0.31823
600	2	432L4	TSAR	8443	3240	0.38375
601	2	462X0	LCOM	8627	18682	2.16553
602	2	462X0	LCOM	8635	18713	2.16711
603	2	462X0	LCOM	8635	18657	2.16063
604	2	462X0	LCOM	8634	18748	2.17142
605	2	462X0	LCOM	8635	18649	2.15970
606	2	462X0	LCOM	8632	18706	2.16705
607	2	462X0	LCOM	8635	18658	2.16074
608	2	462X0	LCOM	8631	18729	2.16997
609	2	462X0	LCOM	8632	18697	2.16601
610	2	462X0	LCOM	8630	18638	2.15968
611	2	462X0	TSAR	8394	17230	2.05266
612	2	462X0	TSAR	8428	17440	2.06929
613	2	462X0	TSAR	8402	17260	2.05427
614	2	462X0	TSAR	8440	17470	2.06991
615	2	462X0	TSAR	8443	17470	2.06917
616	2	462X0	TSAR	8389	17260	2.05746
617	2	462X0	TSAR	8403	17290	2.05760
618	2	462X0	TSAR	8387	17240	2.05556
619	2	462X0	TSAR	8453	17520	2.07264
620	2	462X0	TSAR	8443	17450	2.06680
621	2	462X1	LCOM	8627	23727	2.75032
622	2	462X1	LCOM	8635	23746	2.74997
623	2	462X1	LCOM	8635	23746	2.74997
624	2	462X1	LCOM	8634	23746	2.75029
625	2	462X1	LCOM	8635	23746	2.74997
626	2	462X1	LCOM	8632	23743	2.75058
627	2	462X1	LCOM	8635	23749	2.75032
628	2	462X1	LCOM	8631	23735	2.74997
629	2	462X1	LCOM	8632	23738	2.75000
630	2	462X1	LCOM	8630	23735	2.75029
631	2	462X1	TSAR	8394	23040	2.74482
632	2	462X1	TSAR	8428	23130	2.74442
633	2	462X1	TSAR	8402	23070	2.74577
634	2	462X1	TSAR	8440	23190	2.74763
635	2	462X1	TSAR	8443	23180	2.74547

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
636	2	462X1	TSAR	8389	23040	2.74645
637	2	462X1	TSAR	8403	23070	2.74545
638	2	462X1	TSAR	8387	23030	2.74592
639	2	462X1	TSAR	8453	23200	2.74459
640	2	462X1	TSAR	8443	23180	2.74547
641	3	325X0	LCOM	11668	10355	0.88747
642	3	325X0	LCOM	11577	10094	0.87190
643	3	325X0	LCOM	11654	9813	0.84203
644	3	325X0	LCOM	11606	10584	0.91194
645	3	325X0	LCOM	11628	10485	0.90170
646	3	325X0	LCOM	11633	10162	0.87355
647	3	325X0	LCOM	11628	9732	0.83695
648	3	325X0	LCOM	11654	10043	0.86176
649	3	325X0	LCOM	11644	9887	0.849107
650	3	325X0	LCOM	11632	10350	0.889787
651	3	325X0	TSAR	11131	9900	0.889408
652	3	325X0	TSAR	11159	9500	0.851331
653	3	325X0	TSAR	11173	9720	0.869954
654	3	325X0	TSAR	11078	9520	0.859361
655	3	325X0	TSAR	11084	9750	0.879646
656	3	325X0	TSAR	11151	9800	0.878845
657	3	325X0	TSAR	11135	10180	0.914234
658	3	325X0	TSAR	11154	9860	0.883988
659	3	325X0	TSAR	11097	9770	0.880418
660	3	325X0	TSAR	11133	9860	0.885655
661	3	326S4	LCOM	11668	1916	0.164210
662	3	326S4	LCOM	11577	1552	0.134059
663	3	326S4	LCOM	11654	1594	0.136777
664	3	326S4	LCOM	11606	1678	0.144580
665	3	326S4	LCOM	11628	1391	0.119625
666	3	326S4	LCOM	11633	1716	0.147511
667	3	326S4	LCOM	11628	1569	0.134933
668	3	326S4	LCOM	11654	1652	0.141754
669	3	326S4	LCOM	11644	1335	0.114651
670	3	326S4	LCOM	11632	2019	0.173573
671	3	326S4	TSAR	11131	1650	0.148235
672	3	326S4	TSAR	11159	1620	0.145174
673	3	326S4	TSAR	11173	1650	0.147677
674	3	326S4	TSAR	11078	1540	0.139014
675	3	326S4	TSAR	11084	1850	0.166907
676	3	326S4	TSAR	11151	1680	0.150659
677	3	326S4	TSAR	11135	1470	0.132016
678	3	326S4	TSAR	11154	1530	0.137171
679	3	326S4	TSAR	11097	1530	0.137875
680	3	326S4	TSAR	11133	1750	0.157190
681	3	326S5	LCOM	11668	2849	0.244172
682	3	326S5	LCOM	11577	2823	0.243846
683	3	326S5	LCOM	11654	2809	0.241033
684	3	326S5	LCOM	11606	2846	0.245218

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
685	3	326S5	LCOM	11628	2703	0.232456
686	3	326S5	LCOM	11633	2988	0.256855
687	3	326S5	LCOM	11628	2618	0.225146
688	3	326S5	LCOM	11654	2731	0.234340
689	3	326S5	LCOM	11644	2880	0.247338
690	3	326S5	LCOM	11632	2856	0.245530
691	3	326S5	TSAR	11131	2690	0.241667
692	3	326S5	TSAR	11159	2610	0.233892
693	3	326S5	TSAR	11173	2440	0.218384
694	3	326S5	TSAR	11078	2640	0.238310
695	3	326S5	TSAR	11084	2750	0.248105
696	3	326S5	TSAR	11151	2690	0.241234
697	3	326S5	TSAR	11135	2890	0.259542
698	3	326S5	TSAR	11154	2880	0.258203
699	3	326S5	TSAR	11097	2800	0.252320
700	3	326S5	TSAR	11133	2690	0.241624
701	3	326X6	LCOM	11668	932	0.079877
702	3	326X6	LCOM	11577	898	0.077568
703	3	326X6	LCOM	11654	872	0.074824
704	3	326X6	LCOM	11606	868	0.074789
705	3	326X6	LCOM	11628	815	0.070089
706	3	326X6	LCOM	11633	920	0.079085
707	3	326X6	LCOM	11628	813	0.069917
708	3	326X6	LCOM	11654	907	0.077827
709	3	326X6	LCOM	11644	769	0.066043
710	3	326X6	LCOM	11632	1020	0.087689
711	3	326X6	TSAR	11131	900	0.080855
712	3	326X6	TSAR	11159	800	0.071691
713	3	326X6	TSAR	11173	910	0.081446
714	3	326X6	TSAR	11078	810	0.073118
715	3	326X6	TSAR	11084	930	0.083905
716	3	326X6	TSAR	11151	880	0.078917
717	3	326X6	TSAR	11135	810	0.072744
718	3	326X6	TSAR	11154	800	0.071723
719	3	326X6	TSAR	11097	850	0.076597
720	3	326X6	TSAR	11133	860	0.077248
721	3	326X7	LCOM	11668	1606	0.137641
722	3	326X7	LCOM	11577	1665	0.143820
723	3	326X7	LCOM	11654	1679	0.144071
724	3	326X7	LCOM	11606	1630	0.140445
725	3	326X7	LCOM	11628	1659	0.142673
726	3	326X7	LCOM	11633	1694	0.145620
727	3	326X7	LCOM	11628	1613	0.138717
728	3	326X7	LCOM	11654	1609	0.138064
729	3	326X7	LCOM	11644	1656	0.142219
730	3	326X7	LCOM	11632	1606	0.138067
731	3	326X7	TSAR	11131	1690	0.151828
732	3	326X7	TSAR	11159	1580	0.141590
733	3	326X7	TSAR	11173	1450	0.129777

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
734	3	326X7	TSAR	11078	1540	0.139014
735	3	326X7	TSAR	11084	1590	0.143450
736	3	326X7	TSAR	11151	1590	0.142588
737	3	326X7	TSAR	11135	1710	0.153570
738	3	326X7	TSAR	11154	1590	0.142550
739	3	326X7	TSAR	11097	1640	0.147788
740	3	326X7	TSAR	11133	1540	0.138327
741	3	326X8	LCOM	11668	1580	0.135413
742	3	326X8	LCOM	11577	1627	0.140537
743	3	326X8	LCOM	11654	1506	0.129226
744	3	326X8	LCOM	11606	1607	0.138463
745	3	326X8	LCOM	11628	1528	0.131407
746	3	326X8	LCOM	11633	1566	0.134617
747	3	326X8	LCOM	11628	1583	0.136137
748	3	326X8	LCOM	11654	1554	0.133345
749	3	326X8	LCOM	11644	1604	0.137753
750	3	326X8	LCOM	11632	1568	0.134801
751	3	326X8	TSAR	11131	1530	0.137454
752	3	326X8	TSAR	11159	1480	0.132628
753	3	326X8	TSAR	11173	1430	0.127987
754	3	326X8	TSAR	11078	1490	0.134501
755	3	326X8	TSAR	11084	1530	0.138037
756	3	326X8	TSAR	11151	1550	0.139001
757	3	326X8	TSAR	11135	1530	0.137405
758	3	326X8	TSAR	11154	1560	0.139860
759	3	326X8	TSAR	11097	1420	0.127963
760	3	326X8	TSAR	11133	1460	0.131142
761	3	328X1	LCOM	11668	7396	0.633870
762	3	328X1	LCOM	11577	8219	0.709942
763	3	328X1	LCOM	11654	7460	0.640124
764	3	328X1	LCOM	11606	7677	0.661468
765	3	328X1	LCOM	11628	7957	0.684297
766	3	328X1	LCOM	11633	7665	0.658901
767	3	328X1	LCOM	11628	8013	0.689112
768	3	328X1	LCOM	11654	8201	0.703707
769	3	328X1	LCOM	11644	7748	0.665407
770	3	328X1	LCOM	11632	7492	0.644085
771	3	328X1	TSAR	11131	7640	0.686371
772	3	328X1	TSAR	11159	7410	0.664038
773	3	328X1	TSAR	11173	7550	0.675736
774	3	328X1	TSAR	11078	7270	0.656256
775	3	328X1	TSAR	11084	7560	0.682064
776	3	328X1	TSAR	11151	7130	0.639405
777	3	328X1	TSAR	11135	7390	0.663673
778	3	328X1	TSAR	11154	7320	0.656267
779	3	328X1	TSAR	11097	7830	0.705596
780	3	328X1	TSAR	11133	7240	0.650319
781	3	423X0	LCOM	11668	1722	0.147583
782	3	423X0	LCOM	11577	1641	0.141747

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
783	3	423X0	LCOM	11654	1626	0.139523
784	3	423X0	LCOM	11606	1442	0.124246
785	3	423X0	LCOM	11628	1384	0.119023
786	3	423X0	LCOM	11633	1475	0.126794
787	3	423X0	LCOM	11628	1475	0.126849
788	3	423X0	LCOM	11654	1379	0.118328
789	3	423X0	LCOM	11644	1500	0.128822
790	3	423X0	LCOM	11632	1406	0.120873
791	3	423X0	TSAR	11131	1370	0.123080
792	3	423X0	TSAR	11159	1430	0.128148
793	3	423X0	TSAR	11173	1380	0.123512
794	3	423X0	TSAR	11078	1640	0.148041
795	3	423X0	TSAR	11084	1430	0.129015
796	3	423X0	TSAR	11151	1340	0.120169
797	3	423X0	TSAR	11135	1480	0.132914
798	3	423X0	TSAR	11154	1410	0.126412
799	3	423X0	TSAR	11097	1520	0.136974
800	3	423X0	TSAR	11133	1500	0.134735
801	3	423X1	LCOM	11668	18	0.001543
802	3	423X1	LCOM	11577	24	0.002073
803	3	423X1	LCOM	11654	29	0.002488
804	3	423X1	LCOM	11606	23	0.001982
805	3	423X1	LCOM	11628	19	0.001634
806	3	423X1	LCOM	11633	17	0.001461
807	3	423X1	LCOM	11628	14	0.001204
808	3	423X1	LCOM	11654	30	0.002574
809	3	423X1	LCOM	11644	36	0.003092
810	3	423X1	LCOM	11632	25	0.002149
811	3	423X1	TSAR	11131	20	0.00180
812	3	423X1	TSAR	11159	10	0.00090
813	3	423X1	TSAR	11173	20	0.00179
814	3	423X1	TSAR	11078	10	0.00090
815	3	423X1	TSAR	11084	30	0.00271
816	3	423X1	TSAR	11151	20	0.00179
817	3	423X1	TSAR	11135	20	0.00180
818	3	423X1	TSAR	11154	10	0.00090
819	3	423X1	TSAR	11097	20	0.00180
820	3	423X1	TSAR	11133	20	0.00180
821	3	423X3	LCOM	11668	8751	0.75000
822	3	423X3	LCOM	11577	8683	0.75002
823	3	423X3	LCOM	11654	8740	0.74996
824	3	423X3	LCOM	11606	8704	0.74996
825	3	423X3	LCOM	11628	8721	0.75000
826	3	423X3	LCOM	11633	8725	0.75002
827	3	423X3	LCOM	11628	8721	0.75000
828	3	423X3	LCOM	11654	8740	0.74996
829	3	423X3	LCOM	11644	8733	0.75000
830	3	423X3	LCOM	11632	8724	0.75000
831	3	423X3	TSAR	11131	8340	0.74926

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
832	3	423X3	TSAR	11159	8360	0.74917
833	3	423X3	TSAR	11173	8370	0.74913
834	3	423X3	TSAR	11078	8300	0.74923
835	3	423X3	TSAR	11084	8310	0.74973
836	3	423X3	TSAR	11151	8360	0.74971
837	3	423X3	TSAR	11135	8350	0.74989
838	3	423X3	TSAR	11154	8360	0.74951
839	3	423X3	TSAR	11097	8320	0.74975
840	3	423X3	TSAR	11133	8340	0.74912
841	3	423X4	LCOM	11668	15043	1.28925
842	3	423X4	LCOM	11577	15842	1.36840
843	3	423X4	LCOM	11654	14927	1.28085
844	3	423X4	LCOM	11606	15400	1.32690
845	3	423X4	LCOM	11628	15490	1.33213
846	3	423X4	LCOM	11633	15795	1.35778
847	3	423X4	LCOM	11628	15618	1.34314
848	3	423X4	LCOM	11654	14995	1.28668
849	3	423X4	LCOM	11644	15346	1.31793
850	3	423X4	LCOM	11632	15668	1.34697
851	3	423X4	TSAR	11131	14870	1.33591
852	3	423X4	TSAR	11159	14720	1.31911
853	3	423X4	TSAR	11173	14100	1.26197
854	3	423X4	TSAR	11078	15060	1.35945
855	3	423X4	TSAR	11084	15130	1.36503
856	3	423X4	TSAR	11151	14940	1.33979
857	3	423X4	TSAR	11135	14490	1.30130
858	3	423X4	TSAR	11154	14810	1.32777
859	3	423X4	TSAR	11097	14840	1.33730
860	3	423X4	TSAR	11133	14970	1.34465
861	3	427X5	LCOM	11668	124	0.01063
862	3	427X5	LCOM	11577	130	0.01123
863	3	427X5	LCOM	11654	113	0.00970
864	3	427X5	LCOM	11606	97	0.00836
865	3	427X5	LCOM	11628	132	0.01135
866	3	427X5	LCOM	11633	162	0.01393
867	3	427X5	LCOM	11628	174	0.01496
868	3	427X5	LCOM	11654	130	0.01115
869	3	427X5	LCOM	11644	128	0.01099
870	3	427X5	LCOM	11632	109	0.00937
871	3	427X5	TSAR	11131	120	0.01078
872	3	427X5	TSAR	11159	100	0.00896
873	3	427X5	TSAR	11173	130	0.01164
874	3	427X5	TSAR	11078	110	0.00993
875	3	427X5	TSAR	11084	100	0.00902
876	3	427X5	TSAR	11151	110	0.00986
877	3	427X5	TSAR	11135	110	0.00988
878	3	427X5	TSAR	11154	130	0.01166
879	3	427X5	TSAR	11097	100	0.00901
880	3	427X5	TSAR	11133	110	0.00988

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
881	3	431X1	LCOM	11668	35604	3.05142
882	3	431X1	LCOM	11577	35317	3.05062
883	3	431X1	LCOM	11654	35734	3.06624
884	3	431X1	LCOM	11606	35415	3.05144
885	3	431X1	LCOM	11628	35554	3.05762
886	3	431X1	LCOM	11633	35524	3.05373
887	3	431X1	LCOM	11628	35376	3.04231
888	3	431X1	LCOM	11654	35621	3.05655
889	3	431X1	LCOM	11644	35683	3.06450
890	3	431X1	LCOM	11632	35423	3.04531
891	3	431X1	TSAR	11131	33800	3.03656
892	3	431X1	TSAR	11159	33840	3.03253
893	3	431X1	TSAR	11173	34130	3.05469
894	3	431X1	TSAR	11078	33700	3.04207
895	3	431X1	TSAR	11084	33590	3.03049
896	3	431X1	TSAR	11151	33900	3.04009
897	3	431X1	TSAR	11135	34000	3.05344
898	3	431X1	TSAR	11154	33900	3.03927
899	3	431X1	TSAR	11097	33700	3.03686
900	3	431X1	TSAR	11133	34050	3.05847
901	3	432L4	LCOM	11668	4106	0.35190
902	3	432L4	LCOM	11577	3659	0.31606
903	3	432L4	LCOM	11654	4347	0.37300
904	3	432L4	LCOM	11606	4037	0.34784
905	3	432L4	LCOM	11628	3865	0.33239
906	3	432L4	LCOM	11633	3891	0.33448
907	3	432L4	LCOM	11628	4110	0.35346
908	3	432L4	LCOM	11654	3926	0.33688
909	3	432L4	LCOM	11644	4216	0.36207
910	3	432L4	LCOM	11632	3948	0.33941
911	3	432L4	TSAR	11131	3790	0.34049
912	3	432L4	TSAR	11159	3830	0.34322
913	3	432L4	TSAR	11173	4170	0.37322
914	3	432L4	TSAR	11078	3960	0.35747
915	3	432L4	TSAR	11084	3710	0.33472
916	3	432L4	TSAR	11151	4120	0.36947
917	3	432L4	TSAR	11135	4080	0.36641
918	3	432L4	TSAR	11154	3860	0.34606
919	3	432L4	TSAR	11097	4010	0.36136
920	3	432L4	TSAR	11133	4140	0.37187
921	3	462X0	LCOM	11668	24026	2.05914
922	3	462X0	LCOM	11577	23565	2.03550
923	3	462X0	LCOM	11654	23959	2.05586
924	3	462X0	LCOM	11606	24026	2.07014
925	3	462X0	LCOM	11628	24065	2.06957
926	3	462X0	LCOM	11633	24057	2.06800
927	3	462X0	LCOM	11628	23962	2.06072
928	3	462X0	LCOM	11654	24092	2.06727
929	3	462X0	LCOM	11644	23977	2.05917

OBS	SR	AFSC	MODEL	SORTIES	MANHRS	MNHRSORT
930	3	462X0	LCOM	11632	23993	2.06267
931	3	462X0	TSAR	11131	23420	2.10403
932	3	462X0	TSAR	11159	21970	1.96881
933	3	462X0	TSAR	11173	21830	1.95382
934	3	462X0	TSAR	11078	21340	1.92634
935	3	462X0	TSAR	11084	21720	1.95958
936	3	462X0	TSAR	11151	22700	2.03569
937	3	462X0	TSAR	11135	21940	1.97036
938	3	462X0	TSAR	11154	22070	1.97866
939	3	462X0	TSAR	11097	21760	1.96089
940	3	462X0	TSAR	11133	21840	1.96174
941	3	462X1	LCOM	11668	32499	2.78531
942	3	462X1	LCOM	11577	32219	2.78302
943	3	462X1	LCOM	11654	32464	2.78565
944	3	462X1	LCOM	11606	32381	2.79002
945	3	462X1	LCOM	11628	32387	2.78526
946	3	462X1	LCOM	11633	32409	2.78595
947	3	462X1	LCOM	11628	32384	2.78500
948	3	462X1	LCOM	11654	32472	2.78634
949	3	462X1	LCOM	11644	32398	2.78238
950	3	462X1	LCOM	11632	32414	2.78662
951	3	462X1	TSAR	11131	30560	2.74549
952	3	462X1	TSAR	11159	30650	2.74666
953	3	462X1	TSAR	11173	30660	2.74412
954	3	462X1	TSAR	11078	30430	2.74689
955	3	462X1	TSAR	11084	30430	2.74540
956	3	462X1	TSAR	11151	30610	2.74505
957	3	462X1	TSAR	11135	30580	2.74630
958	3	462X1	TSAR	11154	30640	2.74700
959	3	462X1	TSAR	11097	30470	2.74579
960	3	462X1	TSAR	11133	30750	2.76206

************* T TEST Procedure on AFSC/TDSR Combinations *************

---------------------------- SR=1 AFSC=325X0 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.87546296	0.04600733	0.01454879
TSAR	10	0.86709098	0.04617511	0.01460185

VARIANCES	T	DF	PROB > :T:
UNEQUAL	0.4062	18.0	0.6894
EQUAL	0.4062	18.0	0.6894

FOR HO: VARIANCES ARE EQUAL, F'= 1.01 WITH 9 AND 9 DF
PROB > F'= 0.9915

---------------------------- SR=1 AFSC=326S4 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.15138889	0.03160587	0.00999465
TSAR	10	0.14169124	0.01538966	0.00486664

VARIANCES	T	DF	PROB > :T:
UNEQUAL	0.8724	13.0	0.3988
EQUAL	0.8724	18.0	0.3945

FOR HO: VARIANCES ARE EQUAL, F'= 4.22 WITH 9 AND 9 DF
PROB > F'= 0.0433

---------------------------- SR=1 AFSC=326S5 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.23752315	0.01500824	0.00474602
TSAR	10	0.23553184	0.02072824	0.00655484

VARIANCES	T	DF	PROB > :T:
UNEQUAL	0.2461	16.4	0.8087
EQUAL	0.2461	18.0	0.8084

FOR HO. VARIANCES ARE EQUAL, F'= 1.91 WITH 9 AND 9 DF
PROB > F'= 0.3501

-------------------------- SR=1 AFSC=326X6 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.07729167	0.01089491	0.00344527
TSAR	10	0.07665128	0.00692298	0.00218924

VARIANCES	T	DF	PROB > :T:
UNEQUAL	0.1569	15.2	0.8774
EQUAL	0.1569	18.0	0.8771

FOR H0: VARIANCES ARE EQUAL, F'= 2.48 WITH 9 AND 9 DF
PROB > F'= 0.1929

-------------------------- SR=1 AFSC=326X7 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.14553241	0.00647785	0.00204848
TSAR	10	0.14447751	0.00693286	0.00219236

VARIANCES	T	DF	PROB > :T:
UNEQUAL	0.3516	17.9	0.7293
EQUAL	0.3516	18.0	0.7292

FOR H0: VARIANCES ARE EQUAL, F'= 1.15 WITH 9 AND 9 DF
PROB > F'= 0.8430

-------------------------- SR=1 AFSC=326X8 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.13518519	0.00754123	0.00238475
TSAR	10	0.13518577	0.00833280	0.00263506

VARIANCES	T	DF	PROB > :T:
UNEQUAL	-0.0002	17.8	1.0000
EQUAL	-0.0002	18.0	0.9999

FOR H0: VARIANCES ARE EQUAL, F'= 1.22 WITH 9 AND 9 DF
PROB > F'= 0.7710

-------------------------- SR=1 AFSC=328X1 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.67300926	0.04063615	0.01285028
TSAR	10	0.65594987	0.04102053	0.01297183

VARIANCES	T	DF	PROB > |T|
UNEQUAL	0.9343	18.0	0.3625
EQUAL	0.9343	18.0	0.3625

FOR HO: VARIANCES ARE EQUAL, F'= 1.02 WITH 9 AND 9 DF
PROB > F'= 0.9781

-------------------------- SR=1 AFSC=423X0 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.12752315	0.01292960	0.00408870
TSAR	10	0.12821600	0.01036332	0.00327717

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.1322	17.2	0.8963
EQUAL	-0.1322	18.0	0.8963

FOR HO: VARIANCES ARE EQUAL, F'= 1.56 WITH 9 AND 9 DF
PROB > F'= 0.5202

-------------------------- SR=1 AFSC=423X4 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	1.31358796	0.05271491	0.01666992
TSAR	10	1.31818804	0.06262494	0.01980375

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.1777	17.5	0.8610
EQUAL	-0.1777	18.0	0.8609

FOR HO: VARIANCES ARE EQUAL, F'= 1.41 WITH 9 AND 9 DF
PROB > F'= 0.6160

```
-------------------------- SR=1   AFSC=431X1 --------------------------

VARIABLE: MNHRSORT

MODEL        N               MEAN            STD DEV          STD ERROR

LCOM        10         3.01907407         0.01441857         0.00455955
TSAR        10         3.03284681         0.01954908         0.00618196

VARIANCES          T        DF   PROB > |T|

UNEQUAL     -1.7930     16.6       0.0913
EQUAL       -1.7930     18.0       0.0898

FOR H0: VARIANCES ARE EQUAL, F'=     1.84 WITH 9 AND 9 DF
        PROB > F'= 0.3779

-------------------------- SR=1   AFSC=432L4 --------------------------

VARIABLE: MNHRSORT

MODEL        N               MEAN            STD DEV          STD ERROR

LCOM        10         0.35148148         0.03174274         0.01003794
TSAR        10         0.34354423         0.02796823         0.00884433

VARIANCES          T        DF   PROB > |T|

UNEQUAL      0.5933     17.7       0.5605
EQUAL        0.5933     18.0       0.5604

FOR H0: VARIANCES ARE EQUAL, F'=     1.29 WITH 9 AND 9 DF
        PROB > F'= 0.7122

-------------------------- SR=1   AFSC=462X0 --------------------------

VARIABLE: MNHRSORT

MODEL        N               MEAN            STD DEV          STD ERROR

LCOM        10         2.03668981         0.00164136         0.00051904
TSAR        10         2.10330289         0.00198854         0.00062883

VARIANCES          T        DF   PROB > |T|

UNEQUAL    -81.9415     17.4       0.0001
EQUAL      -81.9415     18.0       0.0001

FOR H0: VARIANCES ARE EQUAL, F'=     1.47 WITH 9 AND 9 DF
        PROB > F'= 0.5767
```

------------------------- SR=2 AFSC=325X0 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.88014138	0.03348167	0.01058783
TSAR	10	0.87737182	0.02037072	0.00644179

VARIANCES	T	DF	PROB > |T|
UNEQUAL	0.2235	14.9	0.8262
EQUAL	0.2235	18.0	0.8257

FOR H0: VARIANCES ARE EQUAL, F'= 2.70 WITH 9 AND 9 DF
PROB > F'= 0.1549

------------------------- SR=2 AFSC=326S4 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.13743402	0.01492530	0.00471979
TSAR	10	0.13685207	0.01617477	0.00511491

VARIANCES	T	DF	PROB > |T|
UNEQUAL	0.0836	17.9	0.9343
EQUAL	0.0836	18.0	0.9343

FOR H0: VARIANCES ARE EQUAL, F'= 1.17 WITH 9 AND 9 DF
PROB > F'= 0.8146

------------------------- SR=2 AFSC=326S5 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.23616357	0.01269046	0.00401307
TSAR	10	0.24247114	0.01807181	0.00571481

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.9033	16.1	0.3797
EQUAL	-0.9033	18.0	0.3783

FOR H0: VARIANCES ARE EQUAL, F'= 2.03 WITH 9 AND 9 DF
PROB > F'= 0.3071

------------------------- SR=2 AFSC=326X6 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.07401068	0.00551224	0.00174312
TSAR	10	0.07722222	0.00770891	0.00243777

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-1.0716	16.3	0.2995
EQUAL	-1.0716	18.0	0.2980

FOR H0: VARIANCES ARE EQUAL, F'= 1.96 WITH 9 AND 9 DF
PROB > F'= 0.3320

------------------------- SR=2 AFSC=326X7 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.14011941	0.00414807	0.00131174
TSAR	10	0.14515909	0.01101002	0.00348168

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-1.3545	11.5	0.2016
EQUAL	-1.3545	18.0	0.1923

FOR H0: VARIANCES ARE EQUAL, F'= 7.05 WITH 9 AND 9 DF
PROB > F'= 0.0077

------------------------- SR=2 AFSC=326X8 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.13586894	0.00543446	0.00171853
TSAR	10	0.13601605	0.00700525	0.00221526

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.0525	17.0	0.9588
EQUAL	-0.0525	18.0	0.9587

FOR H0: VARIANCES ARE EQUAL, F'= 1.66 WITH 9 AND 9 DF
PROB > F'= 0.4611

------------------------- SR=2 AFSC=328X1 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.67540139	0.03927252	0.01241906
TSAR	10	0.68319452	0.02138078	0.00676120

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.5511	13.9	0.5903
EQUAL	-0.5511	18.0	0.5883

FOR H0: VARIANCES ARE EQUAL, F'= 3.37 WITH 9 AND 9 DF
PROB > F'= 0.0845

------------------------- SR=2 AFSC=423X0 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.12694896	0.00558635	0.00176656
TSAR	10	0.12757661	0.01162583	0.00367641

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.1539	12.9	0.8801
EQUAL	-0.1539	18.0	0.8794

FOR H0: VARIANCES ARE EQUAL, F'= 4.33 WITH 9 AND 9 DF
PROB > F'= 0.0398

------------------------- SR=2 AFSC=423X4 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	1.31086669	0.03201922	0.01012537
TSAR	10	1.33423988	0.03807323	0.01203981

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-1.4858	17.5	0.1552
EQUAL	-1.4858	18.0	0.1546

FOR H0: VARIANCES ARE EQUAL, F'= 1.41 WITH 9 AND 9 DF
PROB > F'= 0.6142

-------------------------- SR=2 AFSC=427X5 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.01139860	0.00093601	0.00029599
TSAR	10	0.01033391	0.00096795	0.00030609

VARIANCES	T	DF	PROB > |T|
UNEQUAL	2.5004	18.0	0.0223
EQUAL	2.5004	18.0	0.0223

FOR HO: VARIANCES ARE EQUAL, F'= 1.07 WITH 9 AND 9 DF
PROB > F'= 0.9220

-------------------------- SR=2 AFSC=431X1 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	3.02636563	0.00804896	0.00254530
TSAR	10	3.04068485	0.01459642	0.00461579

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-2.7166	14.0	0.0167
EQUAL	-2.7166	18.0	0.0141

FOR HO: VARIANCES ARE EQUAL, F'= 3.29 WITH 9 AND 9 DF
PROB > F'= 0.0909

-------------------------- SR=2 AFSC=432L4 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.34589786	0.01148884	0.00363309
TSAR	10	0.35735037	0.02403087	0.00759923

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-1.3597	12.9	0.1972
EQUAL	-1.3597	18.0	0.1907

FOR HO: VARIANCES ARE EQUAL, F'= 4.38 WITH 9 AND 9 DF
PROB > F'= 0.0386

------------------------- SR=2 AFSC=462X0 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	2.16478255	0.00433417	0.00137058
TSAR	10	2.06253519	0.00766583	0.00242415

VARIANCES	T	DF	PROB > |T|
UNEQUAL	36.7165	14.2	0.0001
EQUAL	36.7165	18.0	0.0001

FOR H0: VARIANCES ARE EQUAL, F'= 3.13 WITH 9 AND 9 DF
PROB > F'= 0.1046

------------------------- SR=3 AFSC=325X0 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.87261971	0.02535937	0.00801934
TSAR	10	0.87928409	0.01717139	0.00543007

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.6881	15.8	0.5013
EQUAL	-0.6881	18.0	0.5001

FOR H0: VARIANCES ARE EQUAL, F'= 2.18 WITH 9 AND 9 DF
PROB > F'= 0.2609

------------------------- SR=3 AFSC=326S4 -------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.14116737	0.01797887	0.00568542
TSAR	10	0.14619192	0.01043758	0.00330065

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.7643	14.4	0.4570
EQUAL	-0.7643	18.0	0.4546

FOR H0: VARIANCES ARE EQUAL, F'= 2.97 WITH 9 AND 9 DF
PROB > F'= 0.1209

-------------------------- SR=3 AFSC=326S5 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.24159340	0.00890197	0.00281505
TSAR	10	0.24332822	0.01217622	0.00385046

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.3637	16.5	0.7207
EQUAL	-0.3637	18.0	0.7203

FOR H0: VARIANCES ARE EQUAL, F'= 1.87 WITH 9 AND 9 DF
PROB > F'= 0.3645

-------------------------- SR=3 AFSC=326X6 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.07577085	0.00614985	0.00194475
TSAR	10	0.07682438	0.00441104	0.00139489

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.4402	16.3	0.6656
EQUAL	-0.4402	18.0	0.6650

FOR H0: VARIANCES ARE EQUAL, F'= 1.94 WITH 9 AND 9 DF
PROB > F'= 0.3364

-------------------------- SR=3 AFSC=326X7 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.14113371	0.00292218	0.00092408
TSAR	10	0.14304823	0.00689350	0.00217992

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.8086	12.1	0.4343
EQUAL	-0.8086	18.0	0.4293

FOR H0: VARIANCES ARE EQUAL, F'= 5.56 WITH 9 AND 9 DF
PROB > F'= 0.0175

---------------------------- SR=3 AFSC=326X8 ----------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.13516988	0.00334304	0.00105713
TSAR	10	0.13459769	0.00445351	0.00140832

VARIANCES	T	DF	PROB > |T|
UNEQUAL	0.3249	16.7	0.7493
EQUAL	0.3249	18.0	0.7490

FOR HO: VARIANCES ARE EQUAL, F'= 1.77 WITH 9 AND 9 DF
PROB > F'= 0.4057

---------------------------- SR=3 AFSC=328X1 ----------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.66909140	0.02662400	0.00841925
TSAR	10	0.66797248	0.01957594	0.00619046

VARIANCES	T	DF	PROB > |T|
UNEQUAL	0.1071	16.5	0.9160
EQUAL	0.1071	18.0	0.9159

FOR HO: VARIANCES ARE EQUAL, F'= 1.85 WITH 9 AND 9 DF
PROB > F'= 0.3731

---------------------------- SR=3 AFSC=423X0 ----------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.12937883	0.01015813	0.00321228
TSAR	10	0.13029988	0.00821952	0.00259924

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.2229	17.2	0.8262
EQUAL	-0.2229	18.0	0.8261

FOR HO: VARIANCES ARE EQUAL, F'= 1.53 WITH 9 AND 9 DF
PROB > F'= 0.5381

-------------------------- SR=3 AFSC=423X4 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	1.32500336	0.03085763	0.00975804
TSAR	10	1.32922926	0.02992998	0.00946469

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-0.3109	18.0	0.7595
EQUAL	-0.3109	18.0	0.7595

FOR HO: VARIANCES ARE EQUAL, F'= 1.06 WITH 9 AND 9 DF
PROB > F'= 0.9290

-------------------------- SR=3 AFSC=427X5 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.01116707	0.00199079	0.00062954
TSAR	10	0.01006192	0.00100271	0.00031708

VARIANCES	T	DF	PROB > |T|
UNEQUAL	1.5678	13.3	0.1404
EQUAL	1.5678	18.0	0.1343

FOR HO: VARIANCES ARE EQUAL, F'= 3.94 WITH 9 AND 9 DF
PROB > F'= 0.0533

-------------------------- SR=3 AFSC=431X1 --------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	3.05397301	0.00757614	0.00239579
TSAR	10	3.04244608	0.00971996	0.00307372

VARIANCES	T	DF	PROB > |T|
UNEQUAL	2.9578	17.0	0.0088
EQUAL	2.9578	18.0	0.0084

FOR HO: VARIANCES ARE EQUAL, F'= 1.65 WITH 9 AND 9 DF
PROB > F'= 0.4694

--------------------------- SR=3 AFSC=432L4 ---------------------------

VARIABLE: MNHRSORT

MODEL	N	MEAN	STD DEV	STD ERROR
LCOM	10	0.34474901	0.01635385	0.00517154
TSAR	10	0.35642907	0.01423170	0.00450046

VARIANCES	T	DF	PROB > |T|
UNEQUAL	-1.7037	17.7	0.1060
EQUAL	-1.7037	18.0	0.1056

FOR H0: VARIANCES ARE EQUAL, F'= 1.32 WITH 9 AND 9 DF
PROB > F'= 0.6855

****
******** Wilcoxon Rank Sum Procedure on AFSC/TDSR Combinations ********

---------------------- SR=1 AFSC=423X1 ----------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	125.00	105.00	13.10	12.50
TSAR	10	85.00	105.00	13.10	8.50

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 125.00 Z= 1.4881 PROB >|Z|=0.1367

T-TEST APPROX. SIGNIFICANCE=0.1531

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 2.33 DF= 1 PROB > CHISQ=0.1269

--------------------- SR=1 AFSC=423X3 ------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	155.00	105.00	12.34	15.50
TSAR	10	55.00	105.00	12.34	5.50

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 155.00 Z= 4.0101 PROB >|Z|=0.0001

T-TEST APPROX. SIGNIFICANCE=0.0007

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 16.41 DF= 1 PROB > CHISQ=0.0001

--------------------- SR=1 AFSC=427X5 ------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	123.00	105.00	13.20	12.30
TSAR	10	87.00	105.00	13.20	8.70

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 123.00 Z= 1.3254 PROB >|Z|=0.1850

T-TEST APPROX. SIGNIFICANCE=0.2008

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 1.86 DF= 1 PROB > CHISQ=0.1728

```
--------------------- SR=1   AFSC=462X1 ---------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE  MODEL

            AVERAGE SCORES WERE USED FOR TIES


               WILCOXON SCORES (RANK SUMS)

                        SUM OF   EXPECTED    STD DEV      MEAN
LEVEL              N    SCORES   UNDER HO    UNDER HO     SCORE

LCOM              10    155.00     105.00       12.35     15.50
TSAR              10     55.00     105.00       12.35      5.50

        WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
        (WITH CONTINUITY CORRECTION OF .5)
        S=  155.00      Z= 4.0067      PROB >|Z|=0.0001

        T-TEST APPROX. SIGNIFICANCE=0.0008

        KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
        CHISQ=  16.38     DF=  1     PROB > CHISQ=0.0001

--------------------- SR=2   AFSC=423X1 ---------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE  MODEL

            AVERAGE SCORES WERE USED FOR TIES


               WILCOXON SCORES (RANK SUMS)

                        SUM OF   EXPECTED    STD DEV      MEAN
LEVEL              N    SCORES   UNDER HO    UNDER HO     SCORE

LCOM              10    131.00     105.00       13.22     13.10
TSAR              10     79.00     105.00       13.22      7.90

        WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
        (WITH CONTINUITY CORRECTION OF .5)
        S=  131.00      Z= 1.9283      PROB >|Z|=0.0538

        T-TEST APPROX. SIGNIFICANCE=0.0689

        KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
        CHISQ=   3.87     DF=  1     PROB > CHISQ=0.0493
```

---------------------- SR=2 AFSC=423X3 --------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	144.00	105.00	13.15	14.40
TSAR	10	66.00	105.00	13.15	6.60

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 144.00 Z= 2.9269 PROB >|Z|=0.0034

T-TEST APPROX. SIGNIFICANCE=0.0087

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 8.79 DF= 1 PROB > CHISQ=0.0030

---------------------- SR=2 AFSC=462X1 --------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	155.00	105.00	13.20	15.50
TSAR	10	55.00	105.00	13.20	5.50

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 155.00 Z= 3.7489 PROB >|Z|=0.0002

T-TEST APPROX. SIGNIFICANCE=0.0014

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 14.34 DF= 1 PROB > CHISQ=0.0002

--------------------- SR=3 AFSC=423X1 ------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	122.00	105.00	13.23	12.20
TSAR	10	88.00	105.00	13.23	8.80

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 122.00 Z= 1.2473 PROB >|Z|=0.2123

T-TEST APPROX. SIGNIFICANCE=0.2274

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 1.65 DF= 1 PROB > CHISQ=0.1988

--------------------- SR=3 AFSC=423X3 ------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

AVERAGE SCORES WERE USED FOR TIES

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	155.00	105.00	13.12	15.50
TSAR	10	55.00	105.00	13.12	5.50

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 155.00 Z= 3.7717 PROB >|Z|=0.0002

T-TEST APPROX. SIGNIFICANCE=0.0013

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 14.51 DF= 1 PROB > CHISQ=0.0001

---------------------- SR=3 AFSC=462X0 --------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	144.00	105.00	13.23	14.40
TSAR	10	66.00	105.00	13.23	6.60

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 144.00 Z= 2.9103 PROB >|Z|=0.0036

T-TEST APPROX. SIGNIFICANCE=0.0090

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 8.69 DF= 1 PROB > CHISQ=0.0032

---------------------- SR=3 AFSC=462X1 --------------------------------

ANALYSIS FOR VARIABLE MNHRSORT CLASSIFIED BY VARIABLE MODEL

WILCOXON SCORES (RANK SUMS)

LEVEL	N	SUM OF SCORES	EXPECTED UNDER H0	STD DEV UNDER H0	MEAN SCORE
LCOM	10	155.00	105.00	13.23	15.50
TSAR	10	55.00	105.00	13.23	5.50

WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
(WITH CONTINUITY CORRECTION OF .5)
S= 155.00 Z= 3.7418 PROB >|Z|=0.0002

T-TEST APPROX. SIGNIFICANCE=0.0014

KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
CHISQ= 14.29 DF= 1 PROB > CHISQ=0.0002

```
******************************************************************************
****************** T TEST Procedure on Sorties Flown *******************

----------------------------- SR=2 -----------------------------

VARIABLE: SORTIES

MODEL        N             MEAN           STD DEV        STD ERROR

LCOM        10    8632.60000000        2.71620651       0.85893992
TSAR        10    8418.20000000       25.64197947       8.10870588

VARIANCES          T        DF   PROB > |T|

UNEQUAL     26.2936       9.2       0.0001
EQUAL       26.2936      18.0       0.0001

FOR HO: VARIANCES ARE EQUAL, F'=    89.12 WITH 9 AND 9 DF
        PROB > F'= 0.0001

----------------------------- SR=3 -----------------------------

VARIABLE: SORTIES

MODEL        N             MEAN           STD DEV        STD ERROR

LCOM        10   11632.40000000       26.12023481       8.25994350
TSAR        10   11129.50000000       32.74225948      10.35401157

VARIANCES          T        DF   PROB > |T|

UNEQUAL     37.9688      17.2       0.0001
EQUAL       37.9688      18.0       0.0001

FOR HO: VARIANCES ARE EQUAL, F'=     1.57 WITH 9 AND 9 DF
        PROB > F'= 0.5114
```

```
****************************************************************************
************** Wilcoxon Rank Sum Procedure on Sorties Flown *************

---------------------------- SR=1 ------------------------------------

 ANALYSIS FOR VARIABLE SORTIES CLASSIFIED BY VARIABLE  MODEL

              AVERAGE SCORES WERE USED FOR TIES


                 WILCOXON SCORES (RANK SUMS)

                             SUM OF   EXPECTED    STD DEV       MEAN
LEVEL                  N     SCORES   UNDER HO   UNDER HO      SCORE

LCOM                  10     155.00     105.00      12.34      15.50
TSAR                  10      55.00     105.00      12.34       5.50

         WILCOXON 2-SAMPLE TEST (NORMAL APPROXIMATION)
         (WITH CONTINUITY CORRECTION OF .5)
         S=  155.00      Z= 4.0101      PROB >|Z|=0.0001

         T-TEST APPROX. SIGNIFICANCE=0.0007

         KRUSKAL-WALLIS TEST (CHI-SQUARE APPROXIMATION)
         CHISQ=  16.41      DF=  1     PROB > CHISQ=0.0001
```

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BLOCK 19

The purpose of this study was to determine if the Theater Simulation of Airbase Resources (TSAR) model could duplicate the results of the Logistics Composite Model (LCOM). The models were compared on the basis of two outputs -- manhours per sortie and sorties flown. This study reviewed and built upon the work of two previous studies.

Both models were provided common data bases, and each was run for ten replications at three different levels of requested flying activity. These levels represented daily sortie rates of 1.0, 2.0, and 3.0 sorties per aircraft per day. The manhours per sortie expended by each maintenance specialty represented in the data bases, and the number of sorties flown, were gathered for each replication and level. The manhours per sortie were compared on both a statistical and practical basis. The results of this comparison concluded that no significant difference existed between the two models'. A significant statistical difference existed between the models' output sorties flown at each of the three levels. LCOM consistently flew more sorties than did the TSAR model, however this difference (less than 4 percent) is believed to be caused by the values assigned to the various user specified variables TSAR uses to assign aircraft to missions.

Many differences and similarities between the two models' input requirements and features were noted. TSAR provides the analyst with the ability to model a greater spectrum of the wartime environment. The computer execution time of TSAR was found to be 5 to 8 times faster than LCOM. TSAR, however, being a newer model than LCOM, does not provide the analyst the up-front network building programs that LCOM provides. This makes the building of TSAR data bases a more cumbersome task. If analysts find TSAR's unique features useful, this study recommends that the resources be expended to build such up-front programs.